



No Action Decision Document MMRP Sites UXO-01, UXO-02, UXO-07, UXO-08, UXO-10, UXO-11, UXO-17

Marine Corps Installation East - Corine Corps Base Comp Lejeune
Jacksonville, North Carolina
May 2013

1. Declaration

This No Action Decision Document (NADD) presents the No Further Action (NFA) determination for military munitions response program (MMRP) Sites UXO-01 (Archives Search Report [ASR] # 2.23), UXO-02 (ASR# 2.201), UXO-07 (ASR#s 2.77a and 2.77b), UXO-08 (ASR#s 2.182 and 2.80), UXO-10 (ASR# 2.136), UXO-11 (ASR# 2.281), and UXO-17 (ASR# 2.212). Marine Corps Installations East — Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) was placed on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL) effective November 4, 1989 (USEPA ID: NC6170022580). As a result of the NPL listing and pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the USEPA Region 4, North Carolina Department of Environment and Natural Resources (NCDENR), the Navy, and the Marine Corps entered into a Federal Facilities Agreement (FFA) for MCIEAST-MCB CAMLEJ in 1991. The primary purpose of the FFA is to ensure that the environmental impacts associated with past and present activities at the Base are thoroughly investigated and to determine whether additional investigation and/or remediation activities are necessary.

In 2001, the MMRP was established to address military munitions and explosives of concern (MEC) (i.e., unexploded ordnance [UXO] and waste military munitions) and munitions constituents (MC) (i.e., chemical residues of munitions) at ranges that are not operational. The current status and schedule for the MMRP sites is provided in the MCIEAST-MCB CAMLEJ Site Management Plan, which is updated annually and available in the Administrative Record.

Sites UXO-01 (ASR# 2.23), UXO-02, UXO-07, UXO-08, UXO-10, UXO-11, and UXO-17 were investigated under the MMRP, no unacceptable risks to human health or the environment were identified, and NFA was recommended. The NFA determination has been made in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This NFA decision is based on the results of the site investigations and the Administrative Record for MCIEAST-MCB CAMLEJ. The Navy and the Marine Corps issue this NADD and have obtained concurrence from the USEPA Region 4 and NCDENR on the NFA decision. Copies of the USEPA and NCDENR approval letters are presented in **Attachment A**.

1.1 Authorizing Signature

R. F. CASTELLVI

Brigadier General, U.S. Marine Corps

Commanding General

Marine Corps Installations East-Marine Corps Base, Camp Lejeune

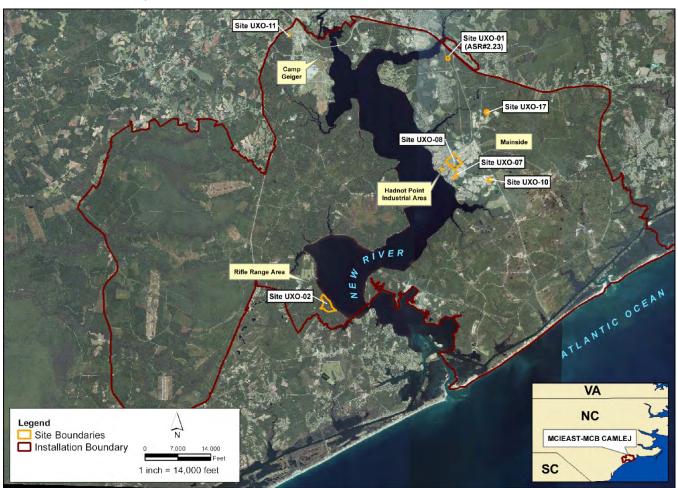
28 July 2013

2. Decision Summary

2.1 Base Description and History

MCIEAST-MCB CAMLEJ is a 156,000-acre facility located in Onslow County, North Carolina adjacent to the southern side of the City of Jacksonville (**Figure 2-1**). The mission of MCIEAST-MCB CAMLEJ is to maintain combat-ready units for expeditionary deployment. The Base provides housing, training facilities, and logistical support for Fleet Marine Force Units and other assigned units.

FIGURE 2-1
Base and Site Location Map



2.2 Site Description and Investigation Summary

The following sections present site descriptions and summaries of environmental investigations, including the results of human health and ecological risk screenings for each site. The methodology for the risk screenings is provided in **Attachment B**.

3. UXO-01 - Former Live Hand Grenade Course (ASR# 2.23)

Site UXO-01 originally included six ASR areas which are listed in **Table 3-1**. Based on investigation results at two of the sites, separate MMRP site numbers (UXO-21 and UXO-26) were designated. This document pertains only to the Former Live Hand Grenade Course, ASR# 2.23 site at UXO-01. Site UXO-01 ASR# 2.64 is being investigated and will be closed out separately.

TABLE 3-1 UXO-01 Sites

Original Site Name	Current Site Name	ASR#	Description
	UXO-01	2.23	Former Live Hand Grenade Course
	UXO-01	2.64	D-6 50-Foot Indoor Rifle and Pistol Range
UXO-01	UXO-21	2.204	Gas Chamber (2D MAR DIV)
	UXO-26	2.79a	B-3 Gas Chamber
		2.79b	
		2.79c	

Site UXO-01, ASR# 2.23 is the Former Live Hand Grenade Course and encompasses approximately 10 acres on the Mainside of the Base (**Figure 3-1**). The Live Hand Grenade Course was established under Camp Training Order Number 7-1946, dated March 19, 1945, and as of March 1946 was no longer used for the firing of live ammunition. During operation of the site, munitions used included fragmentation, offensive, and practice grenades.

Preliminary Assessment/Site Inspection (CH2M HILL, 2009)

In 2009, a Preliminary Assessment/Site Inspection (PA/SI) was initiated at UXO-01 to identify the presence and nature of impacts to environmental media resulting from historical munitions use at the site and to evaluate whether additional investigation or remediation activities were necessary. Surface soil, subsurface soil, and groundwater samples were collected and analyzed for explosives residues, perchlorate, and metals. Metals were detected at concentrations exceeding screening criteria in soil and groundwater (Tables 3-2 through 3-4). No unacceptable risks to human health or the environment were identified during the human health risk screening (HHRS) or the ecological risk screening (ERS) (Table 3-5 and 3-6). 249 geophysical anomalies were detected during digital geophysical mapping (DGM) and an intrusive investigation was recommended.

Expanded Site Investigation (CH2M HILL, 2012)

In 2012, an Expanded Site Investigation (ESI) was conducted to address the PA/SI Report recommendation to intrusively investigate the sources of geophysical anomalies. No MEC or material potentially presenting an explosive hazard (MPPEH) was identified during the intrusive investigation of the 249 anomalies; therefore, NFA was recommended for UXO-01 ASR# 2.23.

FIGURE 3-1 UXO-01 (ASR# 2.23) Sample Locations

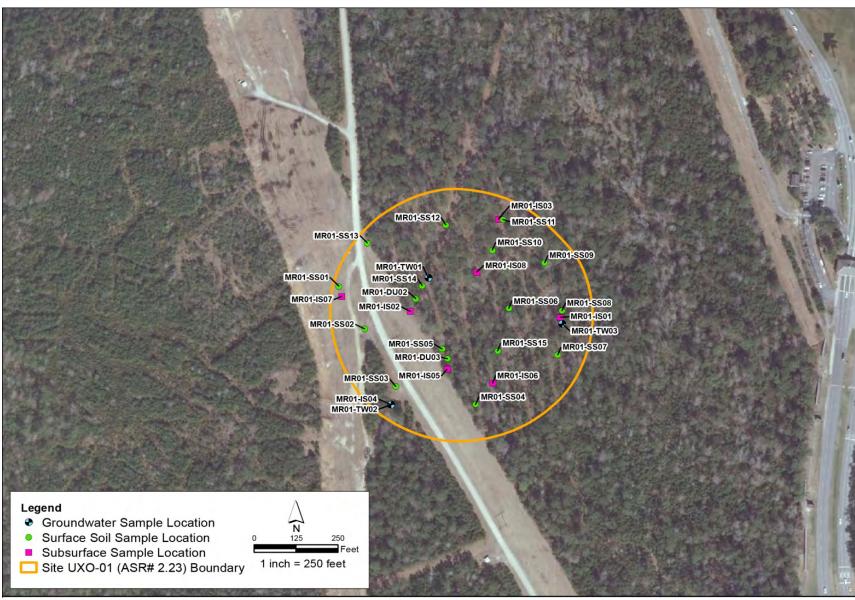


TABLE 3-2 Summary of PA/SI Surface Soil Exceedances - UXO-01 (ASR# 2.23)

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Arsenic	1.8	MR01-SS13	0.626	0.39	1.6	5.24
Iron	3,540	MR01-SS13	3,245	5,500	72,000	151
Manganese	157	MR05-SS15	13.7	180	2,300	65.2
Mercury	0.34	MR01-DU02-SS01	0.081	2.3	31	0.015
Silver	3.1	MR01-DU02-SS01	0.14	39	510	0.217

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 3-3
Summary of PA/SI Subsurface Soil Exceedances - UXO-01 (ASR# 2.23)

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Aluminum	11,500	MR01-IS01-7-8	10,369	7,700	99,000	
Arsenic	3.1	MR01-IS05-18-19	0.626	0.39	1.6	5.24
Iron	5,880	MR01-IS01-7-8	5,439	5,500	72,000	151

Notes

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 3-4 Summary of PA/SI Groundwater Exceedances - UXO-01 (ASR# 2.23)

Analyte	Max Concentration (μg/L)	Location of Max Concentration	2x Mean Background (μg/L)	Adjusted Tap Water RSL (μg/L)	NCGWQS (µg/L)
Cobalt	1.4	MR01-TW03	3.4	1.1	
Iron	7,370	MR01-TW01	5,999	2,600	300
Iron, dissolved	5,720	MR01-TW01D	5,999	2,600	300
Manganese	87.9	MR01-TW01	214	88	50
Manganese, dissolved	76.2	MR01-TW01	214	88	50

Notes

TABLE 3-5 Summary of PA/SI HHRS Results - UXO-01 (ASR# 2.23)

Media	Step 1 Chemicals of Potential Concern (COPCs)	Step 2 COPCs	Step 3 COPCs	Conclusions
Surface Soil	Arsenic	None	None	No unacceptable risk expected from exposure to surface soil.
Total Soil	Aluminum Arsenic Iron	None	None	No unacceptable risk expected from exposure to total soil.
Groundwater	Iron	None	None	No unacceptable risk expected from exposure to groundwater.

TABLE 3-6 Summary of ERS - UXO-01 (ASR# 2.23)

Media	Maximum-Based Hazard Quotient (HQ) >1	Results	Conclusions
Surface Soil	Aluminum Iron Lead Vanadium	Results were within the range of background or the mean concentration was less than ESVs.	No unacceptable risk expected from exposure to surface soil.
Total Soil	Aluminum Antimony Cadmium Iron Lead Vanadium	Results were consistent with background levels, within the range of background, or the mean concentration was less than ESVs.	No unacceptable risk expected from exposure to total soil.
Groundwater	Aluminum Copper Iron Lead Mercury	Results were consistent with background levels, within the range of background, or the mean concentration was less than ESVs.	No unacceptable risk expected from exposure to groundwater.

4. UXO-02 - Unnamed Explosive Range (ASR# 2.201)

Site UXO-02, the Unnamed Explosive Range, encompasses approximately 127 acres along the west bank of the New River in the Rifle Range Area of the Base (**Figure 4-1**). UXO-02 also encompasses IRP Site 69. UXO-02 operated as an explosive range from 1973 to 2002; however, the types of munitions employed at this range are unknown.

Preliminary Assessment/Site Inspection (CH2M HILL, 2012)

In 2009, a PA/SI was initiated at UXO-02 to identify the presence and nature of MC contamination and evaluate the number and density of anomalies that represent potential subsurface MEC. Due to the waste in-place and potential presence of chemical agent, the area within the Site 69 fence was not investigated. Soil, groundwater, surface water, and sediment samples were collected at UXO-02 and analyzed for explosives residues, perchlorate, and metals. Potential unacceptable risks to human health and the environment were identified due to exposure to metals in groundwater. Approximately 1,400 geophysical anomalies were identified during DGM, potentially representing subsurface MEC. The PA/SI report, recommended further investigation of groundwater and geophysical anomalies.

Expanded Site Investigation (CH2M HILL, 2012)

The ESI was conducted at UXO-02 to further investigate potential unacceptable risks identified during the PA/SI. Recommendations of the Site 69 Supplemental Investigation were also addressed during the ESI. Field activities included an intrusive anomaly investigation, monitoring well installation, and soil, groundwater, surface water, and sediment sampling for pesticides, metals, and/or explosives residues analyses. One MEC item was identified during the intrusive anomaly investigation and was disposed of by controlled detonation. Metals were detected at concentrations exceeding screening criteria in groundwater (**Table 4-1**). No unacceptable human health or ecological risks were identified from potential exposure to soil (including post detonation sampling), surface water, and sediment, or to metals in groundwater (**Table 4-2** and **Table 4-3**). Based on these results, risks from exposure to MC in site media and the overall potential hazard due to encountering MEC is low; therefore, NFA was recommended for the portion of UXO-02 located outside of the Site 69 perimeter fence.

TABLE 4-1
Summary of ESI Groundwater Exceedances - UXO-02

Analyte	Max Concentration (μg/L)	Location of Max Concentration	2x Mean Background (μg/L)	Adjusted Tap Water RSL (µg/L)	NCGWQS (µg/L)
Total Metals					
Aluminum	5,340	MR02-IR69-MW12	1,886	3,700	
Antimony	6.8 J	MR02-IR69-MW09	3.28	1.5	6
Arsenic	5.4 J	MR02-MW01		0.045	
Chromium	5.37 J	MR02-IR69-MW12	3.13	0.043	
Cobalt	8.65 J	MR02-MW01	3.4	1.1	
Iron	12,600 J	MR02-IR69-MW12	5,999	2,600	300
Lead	4.07 J	MR02-IR69-MW12	2.8		
Manganese	223	MR02-MW02	214	88	50
Nickel	22.2	MR02-MW01	7.97		
Vanadium	8.17 J	MR02-IR69-MW12	5		

TABLE 4-1 Summary of ESI Groundwater Exceedances - UXO-02

Analyte	Max Concentration (μg/L)	Location of Max Concentration	2x Mean Background (μg/L)	Adjusted Tap Water RSL (µg/L)	NCGWQS (µg/L)
Dissolved Metals					
Arsenic	4.89 J	MR02-MW01		0.045	
Cobalt	8.65 J	MR02-MW01	3.4	1.1	
Iron	1,870	MR02-MW02			300
Manganese	223	MR02-MW02		88	50
Nickel	22.2	MR02-MW01	8		

TABLE 4-2 Summary of ESI HHRS Results – UXO-02

Media	Step 1 Chemicals of Potential Concern (COPCs)	Step 2 COPCs	Step 3 COPCs	Conclusions
Groundwater	Aluminum Antimony Cadmium Chromium Cobalt Iron Manganese Selenium Thallium	Chromium Cobalt	Chromium	All chromium concentrations were below the Tap Water RSL for trivalent chromium; therefore, no unacceptable risk expected from exposure to chromium in groundwater.

TABLE 4-3 Summary of ERS - UXO-02

Media	Maximum-Based Hazard Quotient (HQ) >1	Conclusions
Soil	Endrin	Food chain modeling indicated that pesticides are not present at high enough
	Gamma-BHC	concentrations over a large enough area to significantly impact populations of upper trophic level receptors. Therefore, pesticides in soil and sediment are unlikely to pose
Sediment	4,4'-DDD	significant risks to ecological receptors. Additionally, remedial alternatives are being
	4,4'-DDE	evaluated for the suspected source area (Site 69) that would eliminate any exposure to ecological receptors.
	4,4'-DDT	to ecological receptors.
	Alpha-chlordane	
	Dieldrin	
	Endrin	
	Gamma-BHC	

FIGURE 4-1 UXO-02 Sample Locations



5. UXO-07 - Practice Hand Grenade Course (ASR#s 2.77a and 2.77b)

Site UXO-07, the Practice Hand Grenade Course, encompasses approximately 2 acres in the Hadnot Point Industrial Area (HPIA) (Figure 5-1). UXO-07 was reportedly used as a range in 1953. The types of munitions employed at the site are unknown; however, based on the name of the site it is assumed that practice hand grenades were used.

Preliminary Assessment/Site Inspection (CH2M HILL, 2011)

In 2009, a PA/SI was initiated to identify the presence and nature of MC contamination and evaluate the number and density of anomalies that represent potential subsurface MEC. Field activities included soil, groundwater, surface water, and sediment sampling and 10% DGM (Figure 5-1). Samples were analyzed for semi-volatile organic compounds (SVOCs), explosives residues, perchlorate, and metals. Metals detections exceeded screening criteria in all media except surface water and nitrobenzene and perchlorate detections also exceeded screening criteria in groundwater (Tables 5-1 to 5-4). No unacceptable human health and ecological risks were identified (Table 5-5 and Table 5-6) and no further environmental sampling was recommended; however, 1,118 geophysical anomalies were identified during DGM and an intrusive investigation was recommended.

Expanded Site Investigation (CH2M HILL, 2012)

An ESI was initiated to address recommendations of the PA/SI and the geophysical anomalies identified as representing potential subsurface MEC were intrusively investigated. No MEC items were identified. Three MPPEH items were excavated, inspected, certified, and verified as material documented as safe (MDAS) and recycled. Based on the types of items found, the potential for encountering subsurface MEC is likely to be low and NFA was recommended.

TABLE 5-1
Summary of PA/SI Surface Soil Exceedances - UXO-07

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Aluminum	10,600	MR07-SS38	5,487	7,700	99,000	
Arsenic	9.58	MR07-SS18	0.626	0.39	1.6	5.8
Chromium	19.5	MR07-SS18	6.05	0.29	5.6	3.8
Cyanide	0.546	MR07-SS14		160	2,000	0.28
Iron	6,730	MR07-SS38	3,245	5,500		150

Notes

FIGURE 5-1
UXO-07 Sample Locations

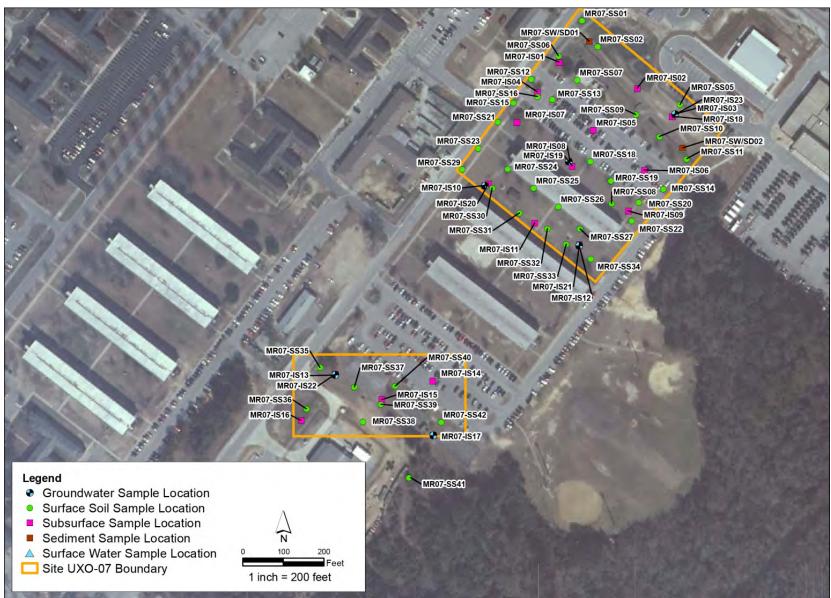


TABLE 5-2 Summary of PA/SI Subsurface Soil Exceedances - UXO-07

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Aluminum	16,000	MR07-IS12-18-19	5,487	7,700	99,000	
Arsenic	15.7	MR07-IS01-11-12	0.626	0.39	1.6	5.8
Chromium	22.2	MR07-IS01-11-12	6.05	0.29	5.6	3.8
Iron	16,000	MR07-IS01-11-12	3,245	5,500	72,000	150
Vanadium	46.4	MR07-IS01-11-12	5	39	520	

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 5-3
Summary of PA/SI Groundwater Exceedances - UXO-07

Analyte	Max Concentration (μg/L)	Location of Max Concentration	2x Mean Background (μg/L)	Adjusted Tap Water RSL (μg/L)	NCGWQS (µg/L)
Nitrobenzene	1.2	MR07-TW03		0.12	
Perchlorate	9.93	MR07-TW17			2
Chromium	3.31	MR07-TW10	3.13	0.043	
Cobalt	35.9	MR07-TW10	3.4	1.1	
Iron	6,600	MR07-TW03	5,999	2,600	300
Manganese	765	MR07-TW10	214	88	50

Notes

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 5-4
Summary of PA/SI Sediment Exceedances - UXO-07

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)
Aluminum	8,420	MR07-SD02	7,700	99,000
Arsenic	2.16	MR07-SD02	0.39	1.6
Chromium	12.8	MR07-SD02	0.29	5.6
Iron	6,870	MR07-SD02	5,500	72,000

Notes

TABLE 5-5
Summary of PA/SI HHRS Results – UXO-07

Media	Step 1 COPCs	Step 2 COPCs	Step 3 COPCs	Conclusions
Surface Soil	Aluminum Arsenic Chromium Iron	Arsenic Chromium	None	No unacceptable risk expected from exposure to surface soil.
Subsurface Soil	Aluminum Arsenic Chromium Iron Vanadium	Arsenic Chromium	Arsenic Chromium	No unacceptable risks for exposure to subsurface soil are expected.
Sediment	Aluminum Arsenic Chromium Iron	None	None	No unacceptable risk expected from exposure to sediment.
Groundwater	Chromium Cobalt Iron Manganese Nitrobenzene Perchlorate	Chromium Cobalt Manganese Nitrobenzene Perchlorate	Chromium Cobalt Manganese Nitrobenzene Perchlorate	No unacceptable risks for exposure to groundwater are expected.

TABLE 5-6 Summary of PA/SI ERS - UXO-07

Media	Maximum-Based HQs*>1	Results	Conclusions
Surface Soil	Aluminum Antimony Cadmium Iron Lead Mercury Selenium Vanadium Zinc	Results were consistent with background levels, the mean-based HQs were <1, or the mean concentration was less than the maximum background concentrations.	No unacceptable risk expected from exposure to surface soil.
Groundwater	Aluminum Cadmium Cadmium, dissolved Iron Iron, dissolved Nickel	Results were consistent with background levels or had a low magnitude of exceedance.	No unacceptable risk expected from exposure to groundwater.
Surface Water	Aluminum Cadmium Cadmium, dissolved	Results were consistent with background levels or had a low magnitude of exceedance.	No unacceptable risk expected from exposure to surface water.
Sediment	None	None	No unacceptable risk expected from exposure to sediment.

6. UXO-08 – 2.36-inch Bazooka Range, Base Chemical Smoke Chamber, and Nuclear, Biological, and Chemical Training Trail (ASR# 2.182), and D-7 Gas Chamber (ASR# 2.80)

Located within the boundaries of IRP Site 78, Site UXO-08 encompasses approximately 144 acres in the HPIA. Areas within UXO-08 include the 2.36-inch Bazooka Range, the D-7 Gas Chamber, and the Base Chemical Smoke (CS) Chamber and Nuclear, Biological, and Chemical (NBC) Training Trail (**Figure 6-1**). The Range Identification and Preliminary Assessment Report (USACE, 2001) identified the D-7 Gas Chamber as being located at Building 756. The D-7 Gas Chamber is estimated to have been used from 1953 to 1961, and is thought to have primarily used tear gas. Base maps and the Range Identification and Preliminary Assessment Report indicate that the operation of the Base CS Chamber and NBC Training Trail took place from 1985 to 1987. The amount of chemical stimulants used during the facilities operation is unknown. Reports have indicated the presence of a suspected firing range, designated as the Lejeune Cantonment 2.36-inch Bazooka Range. Retired Base Explosive Ordnance Disposal (EOD) personnel have reported the findings of bazooka rounds on several occasions and at various locations within Parade Grounds during the 1970s and 1990s.

Focused Preliminary Assessment/Site Inspection (CH2M HILL, 2010)

The focused PA/SI was conducted in support of Military Construction (MILCON) activities for the Hadnot Point Construction Area, Post Office Intersection Area, and Fitness Center that overlap UXO-08 boundaries. Soil, groundwater, surface water, and sediment sampling was conducted, along with 100% DGM. Samples were analyzed for VOCs, SVOCs, explosives residues, perchlorate, and metals. No unacceptable human health or ecological risks were identified in site media in the Fitness Center and Post Office Intersection Area. In the Hadnot Point Construction Area, potential unacceptable human health and ecological risks were identified from exposure to metals and poly-aromatic hydrocarbons (PAHs) in a drainage area and in soil. These risks were addressed as part of Site 78. Approximately 900 anomalies were identified in the MILCON areas and further investigation was recommended.

Preliminary Assessment/Site Inspection (CH2M HILL, 2011)

The PA/SI was conducted to identify the presence and nature of MC contamination and evaluate the number and density of anomalies that could represent potential subsurface MEC at UXO-08. Field activities included soil, groundwater, surface water, and sediment sampling for VOCs, SVOCs, pesticides/polychlorinated biphenyls (PCBs), explosives residues, perchlorate, and metals. Concentrations of analytes exceeded screening criteria in all media and exceedances are shown in **Tables 6-1 through 6-5**; however no unacceptable human health or ecological risks attributable to UXO-08 were identified (**Tables 6-6 and 6-7**). Approximately 48% DGM was also conducted at UXO-08, including the portion of the HPCA that overlaps Site UXO-08. Approximately 3,300 anomalies representing potential subsurface MEC were identified in the overlapping portions of the MILCON areas in the combined DGM surveys. An intrusive investigation of 411 of the anomalies was conducted. Only one MEC item was identified and it was subsequently destroyed onsite. Since the MEC item was determined to be discarded military munitions (DMM), which has no relation to the suspected bazooka firing range or gas chambers, it was considered unlikely that the bazooka firing range was located in this area. Therefore, no further MR actions were recommended.

FIGURE 6-1
UXO-08 Sample Locations

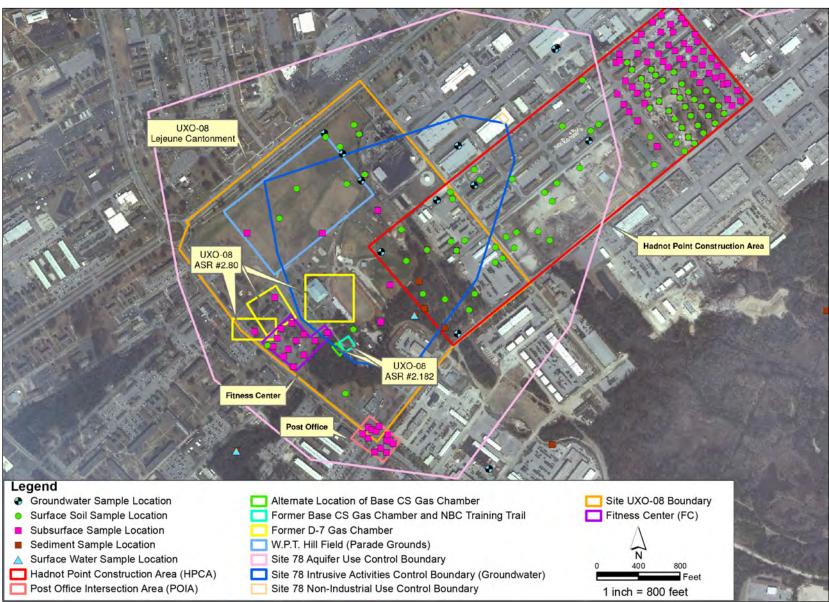


TABLE 6-1
Summary of PA/SI Surface Soil Exceedances - UXO-08

Summary of 1 A/Si Surface Soil L				Adjusted	Adjusted	
Analyte	Max Concentration	Location of Max Concentration	2x Mean Background	Residential RSL	Industrial RSL	NC SSL
Benzene (μg/kg)	9.5	MR08-SS115		1,100	5,400	7.3
Chloromethane (μg/kg)	29	MR08-SS389		12,000	50,000	15
Methylene chloride (μg/kg)	600	MR08-SS067		11,000	53,000	23
Vinyl chloride (μg/kg)	6.7	MR08-SS129		60	1,700	0.19
Benzo(a)anthracene (μg/kg)	230	MR08-SS390		150	2,100	180
Benzo(a)pyrene (μg/kg)	340	MR08-SS056		15	210	59
Benzo(b)fluoranthene (μg/kg)	760	MR08-SS390		150	2,100	600
Dibenzo(a,h)anthracene (μg/kg)	75	MR08-SS056		15	210	190
Hexachlorobenzene (μg/kg)	5.8	MR08-SS056		300	1,100	2.6
Indeno(1,2,3-cd)pyrene (μg/kg)	280	MR08-SS056		150	2,100	2,000
Dieldrin (μg/kg)	49	MR08-SS35		30	110	0.81
Aluminum (mg/kg)	5,680	MR08-SS35	5,487			
Antimony (mg/kg)	10.7	MR08-SS096	0.447	3.1	41	
Arsenic (mg/kg)	16.7	MR08-SS068	0.626	0.39	1.6	5.8
Barium (mg/kg)	910	MR08-SS056	14.5	1,500	19,000	580
Beryllium (mg/kg)	0.25	MR08-SS36	0.103			
Cadmium (mg/kg)	11.3	MR08-SS056	0.033	7.0	80	3.0
Calcium (mg/kg)	297,000	MR08-SS36	6,360			
Chromium (mg/kg)	147	MR08-SS056	6.05	0.29	5.6	3.8
Cobalt (mg/kg)	7.9	MR08-SS35	0.294	2.3	30	
Copper (mg/kg)	5,260	MR08-SS35	4.83	310	4,100	700
Iron (mg/kg)	5,000	MR08-SS36	3.245	5,500	72,000	150
Lead (mg/kg)	224	MR08-SS056	12.3			
Magnesium (mg/kg)	3,790	MR08-SS36	238			
Manganese (mg/kg)	351	MR08-SS36	13.7	180	2,300	65
Mercury (mg/kg)	9.22	MR08-SS056	0.081	2.3	31	1.0
Nickel (mg/kg)	33.7	MR08-SS36	1.21			
Selenium (mg/kg)	5.25	MR08-SS068	0.563	39	510	2.1
Silver (mg/kg)	108	MR08-SS056	0.14	39	510	3.4
Thallium (mg/kg)	1.1	MR08-SS39	0.36			
Vanadium (mg/kg)	15.4	MR08-SS35	8.9			
Zinc (mg/kg)	886	MR08-SS056	10.8			

TABLE 6-2 Summary of PA/SI Subsurface Soil Exceedances - UXO-08

Analyte	Max Concentration	Location of Max Concentration	2x Mean Background	Residential RSL	Industrial RSL	NC SSL
Benzene (μg/kg)	10 J	MR08-IS09-2-3				7.3
Methylene chloride (μg/kg)	3,300	MR08-IS279		11,000	53,000	23
Vinyl Chloride (μg/kg)	12 J	MR08-IS080-5-6				0.19
Benzo(a)anthracene (μg/kg)	1,000	MR08-IS26-2-4		150	2,100	180
Benzo(a)pyrene (μg/kg)	2,500	MR08-IS26-2-4		15	210	59
Benzo(b)fluoranthene (μg/kg)	3,300	MR08-IS26-2-4		150	2,100	600
Dibenzo(a,h)anthracene (μg/kg)	600	MR08-IS26-2-4		15	210	190
Hexachlorobenzene (µg/kg)	2.7	MR08-IS165 MR08-IS188		300	1,100	2.6
Indeno(1,2,3-cd)pyrene (μg/kg)	2,500	MR08-IS26-2-4		150	2,100	2,000
Dieldrin (μg/kg)	4.1 J	MR08-IS39-5-6				0.475
Aluminum (mg/kg)	15,000	MR08-IS22-5-7	10,369	7,700		
Antimony (mg/kg)	3.8 J	MR08-IS26-2-4	0.36	3.1		
Arsenic (mg/kg)	12.9	MR08-IS252	0.626	0.39	1.6	5.8
Barium (mg/kg)	231	MR08-IS056-2-3	16.6			
Beryllium (mg/kg)	0.29 J	MR08-IS24-2-4	0.165			
Cadmium (mg/kg)	2.56	MR08-IS056-2-3	0.023			
Calcium (mg/kg)	103,000 J	MR08-IS24-2-4	441			
Chromium (mg/kg)	35.3	MR08-IS056-2-3	6.05	0.29	5.6	3.8
Cobalt (mg/kg)	1.6 J	MR08-IS24-2-4	0.822			
Copper (mg/kg)	46.9	MR08-IS056-2-3	2.56			
Iron (mg/kg)	9,190	MR08-IS43-5-6	5,439	5,500		150
Lead (mg/kg)	248	MR08-IS24-2-4	8.49			
Magnesium (mg/kg)	1,860	MR08-IS24-2-4	363			
Manganese (mg/kg)	52.5 J	MR08-IS26-2-4	9.25			
Mercury (mg/kg)	1.13	MR08-IS056-2-3	0.071			1
Nickel (mg/kg)	7.2	MR08-IS24-2-4	2.27			
Potassium (mg/kg)	665	MR08-IS24-2-4	361			
Selenium (mg/kg)	0.93 J	MR08-IS24-2-4	.505			
Silver (mg/kg)	25.6	MR08-IS056-2-3	0.129			2.1
Sodium (mg/kg)	246 J	MR08-IS24-2-4	68.3			
Vanadium (mg/kg)	22.7	MR08-IS22-5-7	17.2			
Zinc (mg/kg)	240	MR08-IS056-2-3	6.59			

TABLE 6-3 Summary of PA/SI Groundwater Exceedances - UXO-08

Analyte	Max Concentration (μg/L)	Location of Max Concentration	2x Mean Background (µg/L)	Adjusted Tap Water RSL (µg/L)	NCGWQS (μg/L)
Trichloroethene	4.2	IR78-GW65		2.0	3.0
Cis-1,2-dichloroethene	83	IR78-GW65		37	70
Vinyl chloride	7.7	IR78-GW65		0.016	0.03
Aluminum	1,940	IR78-GW62	1,886		
Antimony	1.52	IR78-GW56	3.28	1.5	
Antimony, dissolved	3.5	IR78-GW66	3.28	1.5	
Arsenic	11.8	IR78-GW64	5.77	0.045	10
Arsenic, dissolved	11.2	IR78-GW64	5.77	0.045	10
Barium	119	IR78-GW54	86.2		
Barium, dissolved	118	IR78-GW54	86.2		
Beryllium	1.3	IR78-GW63	0.308		
Beryllium, dissolved	0.72	IR78-GW63	0.308		
Calcium	182,000	IR78-GW50	69,078		
Calcium, dissolved	193,000	IR78-GW68	69,078		
Chromium	1.9	IR78-GW50	3.13	0.043	
Chromium, dissolved	1.2	IR78-GW50	3.13	0.043	
Cobalt	16.4 J	IR78-GW63	3.4	1.1	
Cobalt, dissolved	15.5	IR78-GW63	3.4	1.1	
Copper	6	IR78-GW62	2.76		
Iron	29,200	IR78-GW50	3.13	0.043	
Iron, dissolved	28,900	IR78-GW50	3.13	0.043	
Magnesium	15,200 J	IR78-GW50	6,363		
Magnesium, dissolved	14,600	IR78-GW50	6,363		
Manganese	500	IR78-GW50	214	88	50
Manganese, dissolved	477	IR78-GW50	214	88	50
Mercury	0.11	IR78-GW61	0.1		
Mercury, dissolved	0.11	IR78-GW50	0.1		
Nickel	15.7	IR78-GW63	7.97		
Nickel, dissolved	16.1	IR78-GW63	7.97		
Potassium	6,780	IR78-GW54	3,277		
Potassium, dissolved	5,760	IR78-GW54	3,277		
Sodium	25,400	IR78-GW68	22,508		
Sodium, dissolved	25,100	IR78-GW68	22,508		
Thallium	4.8	IR78-GW62	3.78		2.00
Zinc	194	IR78-GW54	42.1		
Zinc, dissolved	216	IR78-GW54	42.1		

TABLE 6-4
Summary of PA/SI Surface Water Exceedances - UXO-08

Analyte	Max Concentration (μg/L)	Location of Max Concentration	Adjusted Tapwater RSL (μg/L)	NCSWQS (μg/L)
Bis(2-ethylhexyl)phthalate	2 J	MR08-SW03		1.2
Perchlorate	5.8	MR08-SW03	2.6	
Arsenic	3.26	MR08-SW03	0.045	0.018
Cadmium	1.99	MR08-SW03	1.8	
Chromium	15	MR08-SW02	0.043	
Copper	162	MR08-SW02	150	

Screening criteria reflect values that were current at the time that the report was submitted

TABLE 6-5
Summary of PA/SI Sediment Exceedances - UXO-08

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	Residential RSL (mg/kg)	Industrial RSL (mg/kg)
Benzo(a)pyrene (μg/kg)	62	MR08-SD01	15	
Antimony (mg/kg)	9.56	MR08-SD01	3.1	
Arsenic (mg/kg)	230	MR08-SD01	0.39	1.6
Chromium (mg/kg)	46.5 J	MR08-SD01	0.29	5.6

Notes

TABLE 6-6
Summary of Human Health Risk Assessment (HHRA) - UXO-08¹

	Step 1 COPCs	Step 2 COPCs	Step 3 COPCs	Conclusions
Surface Soil	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Dieldrin Antimony Arsenic Cadmium Chromium Cobalt Copper Lead Manganese Mercury Silver	Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Arsenic Chromium Mercury Lead	Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3- cd)pyrene Arsenic Lead	No unacceptable risk expected from exposure to surface soil; Exposure to metals and PAHs are likely from HPIA activities and not related to MEC or UXO-08. Therefore, the potential unacceptable risks from exposure to surface soil were further evaluated and addressed as part of Site 78.
Subsurface Soil	None	None	None	No unacceptable risk expected from exposure to subsurface soil
Groundwater *	VOCs SVOCs Explosive residues Metals	VOCs SVOCs Explosive residues Metals	VOCs SVOCs Explosive residues Metals	Groundwater does not appear to be impacted by activities at Site UXO-08 and groundwater contamination in the Site UXO-08 area is being addressed under Site 78; and the Site 78 aquifer use control and intrusive activities control boundaries encompass UXO-08 groundwater. No unacceptable risk expected from exposure to groundwater at UXO-08.
Surface Water	Bis(2-ethylhexyl)phthalate Perchlorate Arsenic	Bis (2-ethylhexyl) phthalate Arsenic	None	No unacceptable risk expected from exposure to surface water.
Sediment	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Indeno(1,2,3-CD)pyrene Antimony Arsenic Chromium	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Indeno(1,2,3-CD)pyrene Arsenic Chromium	Due to the quantity of samples (<5 samples), Step 3 was not performed and sediment COPCs were evaluated in Phase II of the HHRA.	No noncarcinogenic hazards or carcinogenic risks were identified above USEPA target levels and no unacceptable risk is expected from exposure to sediment.

^{* -} Due to the combination of HHRA reports, results for groundwater have been summarized in this table and Risk Assessment tables are provided in Appendix C.

¹ The contents of this table were derived from the Human Health Risk sections of the Focused PA/SI (Ch2M HILL, 2010) and the PA/SI (CH2M HILL, 2011).

TABLE 6-7 Summary of ERS- UXO-08²

Media	Maximum-Based HQs>1	Results	Conclusions
Surface Soil	Benzo(a)pyrene Fluoranthene Phenanthrene Pyrene Dieldrin Aluminum Cadmium Copper Iron Lead Manganese Selenium Thallium Vanadium Zinc	Results were consistent with background levels, the mean-based HQs were <1, or the magnitude and/or frequency of exceedance was low.	No unacceptable risk expected from exposure to surface soil.
Subsurface Soil	Benzo(a)pyrene Benzo(b)fluoranthene Benzo(g, h, i)perylene Benzo(k)fluoranthene Chrysene Fluoranthene Indeno(1,2,3-cd)pyrene Pyrene 4,4'-DDD 4,4'-DDT Endrin Aluminum Antimony Cadmium Iron Lead Selenium Vanadium Zinc	Results were consistent with background levels, the mean-based HQs were <1, or the magnitude and/or frequency of exceedance was low.	No unacceptable risk expected from exposure to subsurface soil.
Groundwater	Aluminum Beryllium Iron Mercury Thallium Zinc	Results were consistent with background levels, analytes were not detected in dissolved samples, or analytes had a low magnitude of exceedance.	No unacceptable risk expected from exposure to groundwater.

 $^{^2}$ The contents of this table were derived from the Ecological Risk sections of the Focused PA/SI (Ch2M HILL, 2010) and the PA/SI (CH2M HILL, 2011).

TABLE 6-7 Summary of ERS- UXO-08²

Media	Maximum-Based HQs>1	Results	Conclusions
Surface Water	Bis(2-ethylhexyl)phthalate Arsenic Cadmium Chromium Copper Lead Selenium Zinc	The metals may pose a risk to aquatic receptors and warrant further consideration. Bis(2-ethylhexyl)-phthalate was detected in one of three samples and is a common laboratory contaminant.	No unacceptable risk expected from exposure to surface water based on historical munitions activities; however, metals may pose an unacceptable risk to aquatic receptors and were further evaluated and addressed as part of Site 78.
Sediment	2-methylnaphthalene Benzo(a)anthracene Bis(2-ethylhexyl)phthalate Fluoranthene Fluorene Naphthalene Phenanthrene Antimony Arsenic Cadmium Copper Lead Mercury Zinc	Antimony, arsenic, cadmium, copper, lead, and PAHs in sediment may pose a risk to ecological receptors. Other analytes had average concentrations less than ESVs or were considered laboratory contaminants.	No unacceptable risk expected from exposure to sediment based on historical munitions activities; however, metals and PAHs may pose an unacceptable risk to ecological receptors and were evaluated and addressed as part of Site 78.

7. UXO-10 - D-11A, Flame Tank and Flame Thrower Range (ASR# 2.136)

Site UXO-10, the Flame Tank and Flame Thrower Range, encompasses approximately 10 acres on the Mainside of the Base. UXO-10 was reportedly used as a range from 1970 to 1977 (**Figure 7-1**). The types of munitions used at the range include flame throwers and small arms blank ammunition, which was reportedly used on tanks for demonstration purposes. Demolitions (C-4), white smoke grenades, white phosphorous hand grenades, and flame thrower weapons and blank ammunition for small arms were also used on the course.

Preliminary Assessment/Site Inspection (CH2M HILL, 2011)

In 2009, a field investigation was initiated to identify the presence and nature of MC contamination and evaluate the number and density of anomalies that represent potential subsurface MEC. Field activities included soil and groundwater sampling and 10% DGM. Samples were analyzed for VOCs, SVOCs, total petroleum hydrocarbon (TPH), explosives residues, perchlorate, and metals. Metals were detected in soil samples at concentrations exceeding screening criteria (Table 7-1 and 7-2). One VOC, one SVOC, two explosives, and four metals were detected in groundwater samples at concentrations exceeding screening criteria (Table 7-3). However, no unacceptable human health or ecological risks were identified (Table 7-4 and 7-5). 1,228 geophysical anomalies were present at the site, and an intrusive investigation was recommended.

Expanded Site Investigation (CH2M HILL, 2012)

An ESI was conducted to further investigate geophysical anomalies identified during the PA/SI and an intrusive investigation was conducted. No MEC items were identified. Two MPPEH items were excavated, inspected, certified and verified as MDAS, and recycled. The MPPEH were found in suspected road fill material and did not appear to be related to historical range activities. Because no MEC or MPPEH containing explosive material was found at Site UXO-10, the residual risk from MEC is considered to be low. Therefore, NFA was recommended.

TABLE 7-1
Summary of PA/SI Surface Soil Exceedances - UXO-10

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Benzo(a)pyrene	63	MR10-SS05		15	210	59
Aluminum	8,940	MR10-DU01-SS02	5,487	7,700	99,000	
Arsenic	7.75	MR10-DU03-SS01	0.626	0.39	1.6	5.8
Chromium	13.6	MR10-DU03-SS01	6.05	0.29	5.6	3.8
Cobalt	3.24	MR10-DU03-SS01	2.94	2.3	30	
Iron	4,260	MR10-SS04	3,245	5,500	72,000	150

Notes

FIGURE 7-1
UXO-10 Sample Locations



TABLE 7-2 Summary of PA/SI Subsurface Soil Exceedances - UXO-10

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Aluminum	19,100	MR10-IS25-6-7	5,487	7,700	99,000	
Arsenic	9.05	MR10-IS19-12-13	0.626	0.39	1.6	5.8
Chromium	33.1	MR10-IS25-6-7	6.05	0.29	5.6	3.8
Cobalt	9.51	MR10-IS07-6.5-7	2.94	2.3	30	
Iron	12,100	MR10-IS07-6.5-7	3,245	5,500	72,000	150
Vanadium	47.6	MR10-IS25-6-7	17.2	39	520	

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 7-3
Summary of PA/SI Groundwater Exceedances - UXO-10

Analyte	Max Concentration (μg/L)	Location of Max Concentration	2x Mean Background (μg/L)	Adjusted Tap Water RSL (μg/L)	NCGWQS (μg/L)
1,4-Dichlorobenzene	0.68	MR10-TW09		0.43	
Hexachlorobenzene	0.025	MR10-TW07			0.02
2-nitrotoluene	0.34	MR10-TW17		0.31	
Nitrobenzene	0.71	MR10-TW34		0.12	
Arsenic	10.6	MR10-TW07	5.77	0.045	10
Cobalt	41.6	MR10-TW07	0.12	0.12	
Iron	19,200	MR10-TW09	5,999	2,600	300
Manganese	441	MR10-TW09	214	88	50

Notes

TABLE 7-4
Summary of PA/SI HHRS Results – UXO-10

Media	Step 1 COPCs	Step 2 COPCs	Step 3 COPCs	Conclusions
Surface Soil	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Aluminum Arsenic Chromium	None	None	No unacceptable risks are expected from exposure to surface soil.
Subsurface Soil	Aluminum Arsenic Chromium Iron Vanadium	Arsenic Chromium	-	No unacceptable risks are expected from exposure to subsurface soil.
Groundwater	1,4-dichlorobenzene 2-nitrotoluene Nitrobenzene Arsenic Chromium Cobalt Iron Manganese	1,4-dichlorobenzene 2-nitrotoluene Nitrobenzene Arsenic Chromium Cobalt Iron	1,4- dichlorobenzene 2-nitrotoluene Nitrobenzene Arsenic Chromium Cobalt	COPCs identified for groundwater after the three-step screening process are not likely site-related, as their concentrations were not elevated and did not present unacceptable risk in soil. Therefore, no unacceptable risk is expected from exposure to groundwater.

TABLE 7-5
Summary of PA/SI ERS Results - UXO-10

Media	Maximum-Based HQs>1	Results	Conclusions
Surface Soil	Aluminum Cadmium Iron Lead Selenium Vanadium Zinc	Results were consistent with background levels, within the range of background, the mean concentration was less than ESVs, or analytes had a low magnitude of exceedance.	No unacceptable risk expected from exposure to surface soil.
Subsurface Soil	Aluminum Iron Vanadium	Results were generally within the range of background.	No unacceptable risk expected from exposure to subsurface soil.
Groundwater	Aluminum Beryllium Iron Nickel Zinc	Results were consistent with background levels or within the range of background or had low frequencies of exceedance.	No unacceptable risk expected from exposure to groundwater.

8. UXO-11 - B-5, Practice Hand Grenade Course (ASR# 2.281)

Site UXO-11, the Practice Hand Grenade Course, encompasses approximately 2 acres located in Camp Geiger in the northwest portion of the Base (**Figure 8-1**). UXO-11 was reportedly used as a range in 1953. The types of munitions use at the site are unknown; however, it is assumed that practice hand grenades were used.

Preliminary Assessment/Site Inspection (CH2M HILL, 2011)

In 2009, a PA/SI was initiated to identify the presence and nature of MC contamination and evaluate the number and density of anomalies that represent potential subsurface MEC. Field activities included soil, groundwater, surface water, and sediment sampling and 10% DGM (Figure 8-1). Samples were analyzed for explosives residues, perchlorate, and metals. Explosives residues and metals were detected in soil and groundwater samples at concentrations exceeding screening criteria (Table 8-1 to 8-3). Metals were detected in sediment samples at concentrations exceeding screening criteria (Table 8-4). No unacceptable human health or ecological risks were identified (Tables 8-5 and 8-6). An intrusive investigation was recommended to assess the 70 geophysical anomalies and additional sampling was recommended to further evaluate the detections of explosives residues and chromium.

Expanded Site Investigation (CH2M HILL, 2012)

In 2011, an ESI was initiated to address recommendations of the PA/SI. Field activities included an intrusive investigation and soil sampling for explosives residues and chromium. Explosives residues were not detected and chromium was detected at concentrations exceeding screening criteria. An HHRS and ERS were conducted to evaluate data collected during the PA/SI and the ESI. No unacceptable human health or ecological risks were identified due to exposure to site media. No MEC items were identified during the intrusive investigation and six MPPEH items (including inert training hand grenades and small arms casings) were excavated, inspected, certified and verified as MDAS, and recycled. The potential for encountering unidentified subsurface MEC is likely to be low; therefore, NFA was recommended at Site UXO-11.

FIGURE 8-1
UXO-11 Sample Locations

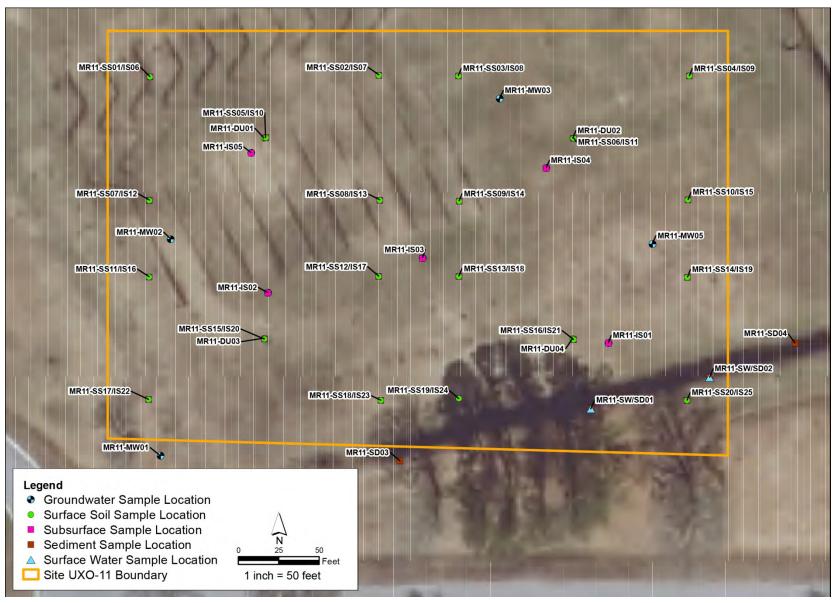


TABLE 8-1 Summary of PA/SI and ESI Surface Soil Exceedances - UXO-11

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Nitroglycerine	920	MR11-DU03		610	6,200	
Arsenic	1.19	MR11-DU04	0.626	0.39	1.6	5.8
Total Chromium	10.7	MR11-SS20	6.05	0.29	5.6	3.8
Hexavalent Chromium	2.4	MR11-SS15		0.29	5.6	3.8
Cyanide	0.645	MR11-DU02		160	2,000	0.28
Iron	2,280	MR11-DU04	3,245	5,500	72,000	150

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 8-2
Summary of PA/SI and ESI Subsurface Soil Exceedances - UXO-11

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Aluminum	13,600	MR11-IS03	10,369	7,700	99,000	
Arsenic	1.4	MR11-IS03	2.12	0.39	1.6	5.8
Total Chromium	22	MR11-IS12	14.5	0.29	5.6	3.8
Hexavalent Chromium	13	MR11-IS14		0.29	5.6	3.8
Iron	6,920	MR11-IS04	5,439	5,500	72,000	150

Notes

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 8-3
Summary of PA/SI Sediment Exceedances - UXO-11

Analyte	Max Concentration (mg/kg)	Location of Max Adjusted Residen RSL Concentration (mg/kg)		Adjusted Industrial RSL (mg/kg)
Aluminum	10,300	MR11-SD01	7,700	99,000
Arsenic	1.55	MR11-SD01	0.39	1.6
Chromium	17.8	MR11-SD01	0.29	5.6

Notes

TABLE 8-4
Summary of PA/SI Groundwater Exceedances - UXO-11

Analyte	Max Concentration (µg/L)	Location of Max Concentration	2x Mean Background (μg/L)	Adjusted Tap Water RSL (µg/L)	NCGWQS (μg/L)
Nitrobenzene	0.48	MR11-IS02		0.12	
Arsenic	2.36	MR11-IS04	5.77	0.045	10
Chromium	25.4 J	MR11-MW01	3.13	0.043	10
Cobalt	4.3	MR11-IS04	3.4	1.1	

TABLE 8-5
Summary of ESI HHRS Results - UXO-11

Media	Step 1 COPCs	Step 2 COPCs	Step 3 COPCs	Conclusions
Surface Soil	Nitroglycerin Arsenic Chromium	None	None	No unacceptable risk expected from exposure to surface soil.
Subsurface Soil	Aluminum Arsenic Chromium Iron	None	None	No unacceptable risk expected from exposure to subsurface soil.
Sediment	Aluminum Arsenic	None	None	No unacceptable risk expected from exposure to sediment.
Groundwater	Nitrobenzene Arsenic Cobalt	Nitrobenzene Arsenic	None	No unacceptable risk expected from exposure to groundwater.

TABLE 8-6
Summary of PA/SI ERS Results - UXO-11

Media	Maximum-Based HQs>1	Results	Conclusions
Surface Soil	Aluminum Cadmium Iron Lead Vanadium	Results were consistent with background levels, within the range of background, the mean concentration was less than ESVs, and/or analytes had a low magnitude of exceedance.	No unacceptable risk expected from exposure to surface soil.
Subsurface Soil	Aluminum Iron Vanadium	Results were consistent with background.	No unacceptable risk expected from exposure to subsurface soil.
Groundwater	Aluminum Beryllium Cadmium Iron	Results were consistent with background levels, not detected in dissolved samples, or had low magnitudes of exceedance.	No unacceptable risk expected from exposure to groundwater.
Surface Water	Cadmium	Cadmium had a low magnitude of exceedance.	No unacceptable risk expected from exposure to surface water.
Sediment	Lead Zinc	Mean HQ for zinc less than one and concentrations of lead in surface soil onsite did not exceed ESVs suggesting concentrations in sediment are not likely to pose an unacceptable risk.	No unacceptable risk expected from exposure to sediment.

9. UXO-17 - Firing Position #2 (ASR# 2.212)

Site UXO-17, Firing Position #2, is located in the Mainside area of the Base and was a gun position used for military training, which fired into the G-10 impact area (**Figure 9-1**). Firing Position #2 covers 16 acres and was reportedly used from the 1950s through at least 1985. 105 mm and 155 mm Howitzer guns were reportedly fired from this site.

Preliminary Assessment/Site Inspection (CH2M HILL, 2012)

In 2009, a PA/SI was initiated to evaluate the potential presence of MEC and to characterize potential impacts to site media. This investigation was completed in three phases. Phase I consisted of 100 percent DGM and intrusive investigation of a 4-acre area in the center of the site and environmental sampling. Phase II consisted of 9 percent DGM and intrusive investigation of the surrounding 12 acres and environmental sampling of soil and groundwater. Phase III consisted of groundwater sampling in the vicinity of a buried leaking drum which was discovered and removed during Phase I.

Soil and groundwater samples were collected and analyzed for VOCs, SVOCs, explosives residues, and metals. Metals were detected in surface soil, subsurface soil, sediment, and groundwater at concentrations exceeding screening criteria (Tables 9-1 through 9-4); however, no unacceptable human health or ecological risks were identified (Tables 9-5 and 9-6). Approximately 32 percent of Site UXO-17 was surveyed yielding a total of 1,992 geophysical anomalies and 21 saturated response areas potentially representing subsurface MEC. One MEC and 279 MPPEH items were identified during the intrusive investigation. The MEC item was found within the 4-acre firing position and was determined to be DMM associated with the historical use of the site. The MPPEH items found were consistent with the site's use for training. No additional investigation was recommended at Site UXO-17 because no unacceptable human health or ecological risks were identified from exposure to site media, there was significant reduction in risk of contact with MEC due to the 100% intrusive anomaly investigation of the 4-acre firing position, intrusive anomaly investigations over 9% of the surrounding 12-acre area did not identify the presence of MEC items, and the site will be used as an above grade expansion area for the Base landfill, potentially covering any remaining subsurface debris. Prior to MILCON proceeding at the site, all site personnel conducting subsurface/intrusive activities were recommended to receive "3R" munitions awareness training for recognizing, retreating, and reporting potential MEC hazards. On-call construction support was also recommended for inspection and disposal of suspected MEC/MPPEH that may be unearthed.

TABLE 9-1
Summary of PA/SI Surface Soil Exceedances - UXO-17

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Residential RSL (mg/kg)	Industrial RSL (mg/kg)	NC SSL (mg/kg)
Arsenic	1.93	MR17-SS07	0.626	0.39	1.6	0.29
Cadmium	1.5 J	MR17-DU01	0.033			0.38
Chromium	8.73	MR17-SS07	6.05	0.29	5.6	3.8
Cobalt	2.4	MR17-DU01	0.294	2.3		
Iron	3,810	MR17-SS12	3,245	-		150
Manganese	186	MR17-DU01	13.7	180		65
Selenium	1.15	MR17-SS07	0.563			0.26

Notes

FIGURE 9-1 UXO-17 Sample Locations

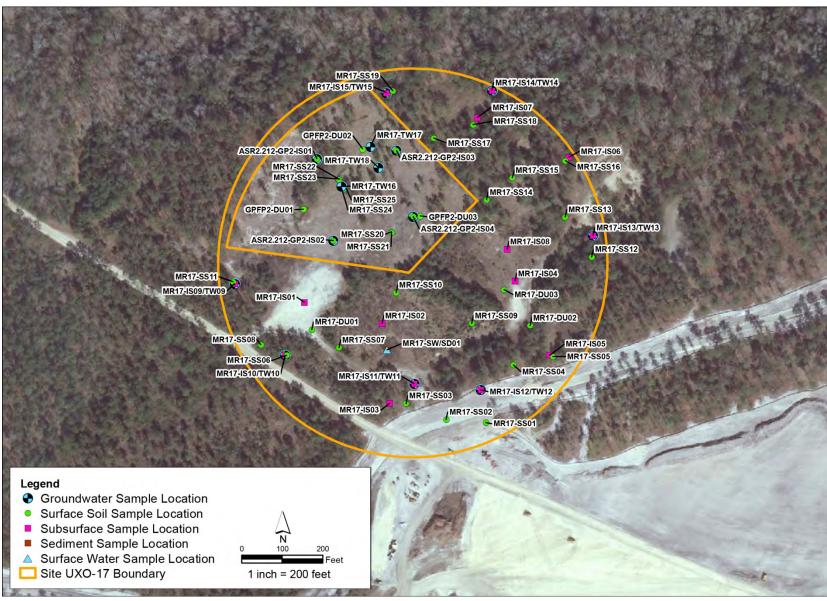


TABLE 9-2 Summary of PA/SI Subsurface Soil Exceedances - UXO-17

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	2x Mean Background (mg/kg)	Adjusted Residential RSL (mg/kg)	Adjusted Industrial RSL (mg/kg)	NC SSL (mg/kg)
Aluminum	13,700	MR17-IS14	10,369	7,700		
Arsenic	2.98	MR17-IS13	0.626	0.39	1.6	0.29
Chromium	16.3	MR17-IS14	6.05	0.29	5.6	3.8
Iron	6,590	MR17-IS02	3,245			150
Selenium	0.66	MR17-IS02	0.563			0.26

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 9-3
Summary of PA/SI Sediment Exceedances - UXO-17

Analyte	Max Concentration (mg/kg)	Location of Max Concentration	Residential RSL (mg/kg)
Aluminum	10,800	MR17-SD01	7,700
Arsenic	1.85	MR17-SD01	0.39
Chromium	12.3	MR17-SD01	0.29

Notes

Screening criteria reflect values that were current at the time that the report was submitted.

TABLE 9-4 Summary of 2011 PA/SI Groundwater Exceedances - UXO-17

Analyte	Max Concentration (μg/L)	Location of Max Concentration	2x Mean Background (μg/L)	Adjusted Tap Water RSL (µg/L)	NCGWQS (μg/L)
Chromium	10.4	ASR2.212-FR2-TW01	3.13	0.043	10
Cobalt	4.3	MR17-MW14	3.4	1.1	
Iron	723 J-	MR17-TW15			300
Manganese	80.8	MR17-TW12			50
Chromium, dissolved	1.53 J	MR17-TW12		0.043	
Manganese, dissolved	78	MR17-TW12			50

Notes

TABLE 9-5
Summary of PA/SI HHRS Results – UXO-17

Media	Step 1 COPCs	Step 2 COPCs	Step 3 COPCs	Conclusions
Surface Soil	Arsenic Chromium Cobalt Manganese	None	None	No unacceptable risk expected from exposure to surface soil.
Subsurface Soil	Aluminum Arsenic Chromium Iron	Arsenic Chromium	None	No unacceptable risk expected from exposure to subsurface soil.
Groundwater	Cobalt Chromium	Chromium	Chromium	All chromium concentrations were below the Tap Water RSL for trivalent chromium; therefore, no unacceptable risk expected from exposure to chromium in groundwater.
Surface Water	Perchlorate	Perchlorate	Perchlorate	Based on the conservative screening process for surface water, it is unlikely there would be any unacceptable risks associated with exposure to perchlorate in the site surface water.
Sediment	Aluminum Arsenic Chromium	None	None	No unacceptable risk expected from exposure to sediment.

TABLE 9-6
Summary of PA/SI ERS Results – UXO-17

Media	Maximum-Based HQs>1	Results	Conclusions
Surface Soil	Aluminum Cadmium Iron Lead Selenium Vanadium	Results were consistent with background levels or the mean based HQs were <1.	No unacceptable risk expected from exposure to surface soil.
Subsurface Soil	Aluminum Iron Selenium Vanadium	Results were consistent with background levels or there was a low magnitude of exceedance.	No unacceptable risk expected from exposure to subsurface soil.
Groundwater	None		No unacceptable risk expected from exposure to groundwater.
Surface Water	Aluminum Cadmium	Low magnitude of exceedances or COPCs not detected in filtered samples.	No unacceptable risk expected from exposure to surface waters
Sediment	None		No unacceptable risk expected from exposure to sediment.

Maximum based HQs are based on detected concentrations

10. NFA Determination

Based on results of the site assessments, there are no unacceptable risks to human health or the environment for current and potential future use at Sites UXO-01 (ASR#2.23), UXO-02 (ASR# 2.201), UXO-07 (ASR#s 2.77a and 2.77b), UXO-08 (ASR#s 2.182 and 2.80), UXO-10 (ASR# 2.136), UXO-11 (ASR# 2.281), and UXO-17 (ASR# 2.212). The Navy and Marine Corps, with concurrence by the USEPA Region 4 and NCDENR, determine NFA is warranted (Attachment A). The no action determination meets the statuary requirements of CERCLA and the regulatory requirements of the NCP for protection of human health and the environment.

11. Community Participation

The Navy, MCIEAST-MCB CAMLEJ, USEPA, and NCDENR provide information regarding the environmental cleanup of sites at MCIEAST-MCB CAMLEJ to the public through the community relations program, which includes a Restoration Advisory Board (RAB), public meetings, the Administrative Record file for the site, and announcements published in local newspapers. RAB meetings are held quarterly and open to the public to provide an information exchange among community members, the Navy, MCIEAST-MCB CAMLEJ, USEPA, and NCDENR.

References

CH2M HILL. 2009. Preliminary Site Assessment/Site Inspection Report, MMRP Site UXO-01, Former Live Hand Grenade Course, Marine Corps Base, Camp Lejeune, North Carolina. March.

CH2M HILL. 2011. Supplemental Investigation, Site 69, Operable Unit No. 14 – Rifle Range Unnamed Explosive Contaminated Range, (ASR #2.201) Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. May.

CH2M HILL. 2011. Final Preliminary Site Assessment/Site Inspection Report, MMRP Site UXO-11, B-5 Practice Hand Grenade Course (ASR# 2.81), Marine Corps Base, Camp Lejeune, North Carolina. June.

CH2M HILL. 2011. Final Preliminary Site Assessment/Site Inspection Report MMRP Site UXO-07, Former D-6 Practice Hand Grenade Course (ASR# 2.77), Marine Corps Base, Camp Lejeune, North Carolina. June.

CH2M HILL. 2011. Final Preliminary Site Assessment/Site Inspection Report, MMRP Site UXO-10, Former D-11A Flame Tank and Flame Thrower Range (ASR# 2.136), Marine Corps Base, Camp Lejeune, North Carolina. July.

CH2M HILL. 2011. Final Expanded Site Investigation Report, MMRP Site UXO-07 (ASR # 2.77) Former Practice Hand Grenade Course, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. December.

CH2M HILL. 2011. Final Expanded Site Investigation Report, MMRP Site UXO-11, B-5 Practice Hand Grenade Course (ASR# 2.81), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. December.

CH2M HILL. 2012. Expanded Site Investigation Report, MMRP Site UXO-01 (ASR #2.23) – Former Live Hand Grenade Course, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. January.

CH2M HILL. 2012. Preliminary Assessment/ Site Inspection Report MMRP Site UXO-02, Unnamed Explosive Contaminated Range, ASR #2.201, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. January.

CH2M HILL. 2012. Final Preliminary Assessment/Site Inspection Report MMRP Site UXO-17, Former Firing Position 2 (ASR#2.212), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. February.

CH2M HILL. 2012. Draft Expanded Site Investigation Report MMRP Site UXO-02 – Former Unnamed Explosive Contaminated Range, ASR # 2.201, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. March.

CH2M HILL. 2012. Final Expanded Site Investigation Report, MMRP Site UXO-10, Former D-11A Flame Tank and Flame Thrower Range (ASR# 2.136), Marine Corps Base, Camp Lejeune, North Carolina. March.

United States Army Corps of Engineers (USACE). 2001. Range Identification and Preliminary Assessment Report.

1

Acronyms and Abbreviations

BBG base background values

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act of 1980

COPC Chemical of potential concern

CS chemical smoke
DCA dichloroethane
DCE dichloroethene

DGM digital geophysical mapping DMM discarded military munitions

EOD Explosive Ordnance Disposal ERS Ecological Risk Screening ESI Expanded Site Investigation

EU exposure unit

FFA Federal Facilities Agreement

FY Fiscal year

HHRA Human Health Risk Assessment
HHRS Human Health Risk Screening

HI hazard index

HPIA Hadnot Point Industrial Area

HQ Hazard Quotient

MC munitions constituents

MCIEAST-MCB CAMLEJ Marine Corps Installations East – Marine Corps Base Camp Lejeune

MDAS material documented as safe

MEC munitions and explosives of concern

mg/kg milligram per kilogram

mg/L milligram/liter

MICON military construction

MMRP Military munitions response Program

MPPEH material potentially presenting an explosive hazard

NADD No Action Decision Document NBC Nuclear, biological, chemical

NCDENR North Carolina Department of Environment and Natural Resources

NCGWQS North Carolina Groundwater Quality Standard NCSWQS North Carolina Surface Water Quality Standard

NCP National Oil and Hazardous Substances Pollution Contingency Plan

NC SSL North Carolina Soil Screening Level

NFA No Further Action
NPL National Priorities List

PAH poly-aromatic hydrocarbon

PA/SI Preliminary Assessment/Site Inspection

PCB polychlorinated biphenyl

1

RAB Restoration Advisory Board RSL regional screening level

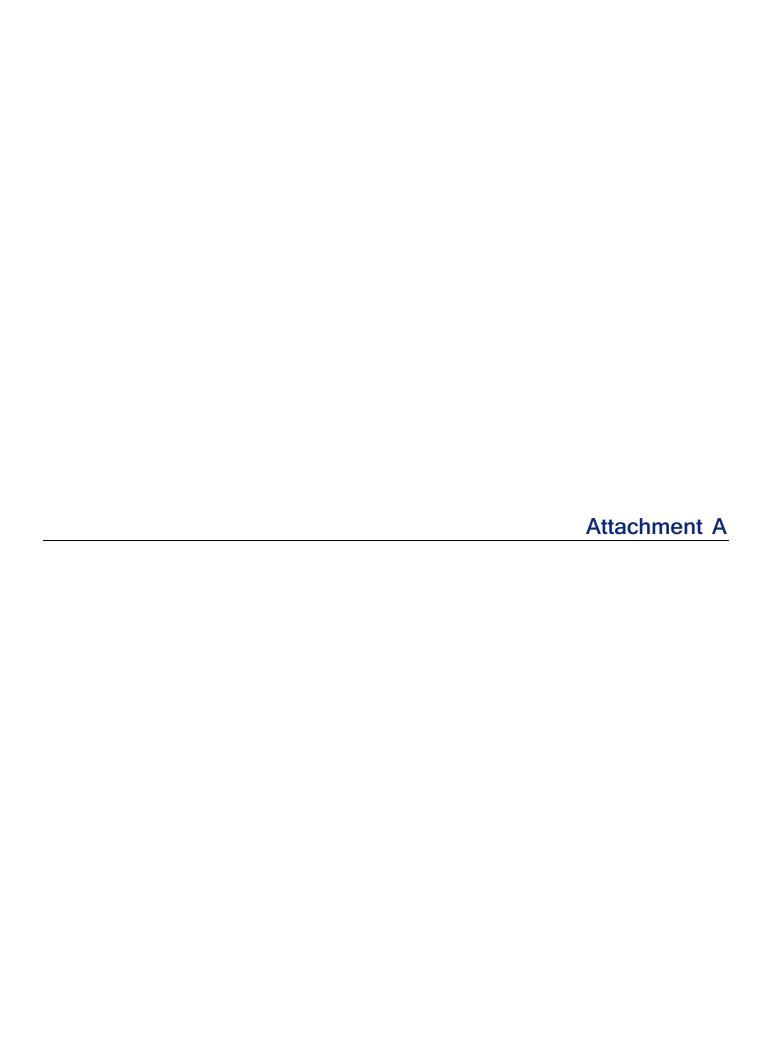
SARA Superfund Amendments and Reauthorization Act of 1986

SVOCs semi-volatile organic compounds

TCE trichloroethene

TPH total petroleum hydrocarbon

 $\begin{array}{ll} \mu g/kg & \text{micrograms/kilogram} \\ \mu g/L & \text{micrograms/liter} \end{array}$





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, S.W.
ATLANTA, GEORGIA 30303

November 30, 2011

NAVFAC Atlantic Attn: David Cleland NAVFAC Midlant Environmental RPM, Camp Lejeune Marine Corps North Carolina IPT 6506 Hampton Blvd Norfolk, VA 23508-1273

SUBJ: MCB Camp Lejeune

Draft Expanded Site Investigation Report Site UXO-01 Military Munitions Response Program ASR #2.23 – Former Live Hand Grenade Course

Dear Mr. Cleland:

The Environmental Protection Agency (EPA) has completed its review of the above subject document, dated September, 2011 and has one minor comment. EPA agrees with the documented recommendation of "no further action" for Site UXO-01. However, more discussion should be included to provide the rationale for selecting the designated "one acre" area for investigation as opposed to the other remaining nine acres. Upon addressing this comment the document can be prepared as final.

If there are any questions, I can be reached at (404) 562-8538.

Sincerely,
Gena
Digitally signed by Gena Townsend
Dix: cn-Gena Townsend, o-Superfund
Division, Federal Facilities Branch,
ou-Environmental Protection Agency,
enailly-townsend, genegepea_gov, c-US
Date: 2011.11.30 14:16:23

cc: Martha Morgan, NCDENR Charity Rychak, MCB Camp Lejeune



North Carolina Department of Environment and Natural Resources

Division of Waste Management

Beverly Eaves Perdue Governor Dexter R. Matthews
Director

Dee Freeman Secretary

November 22, 2011

NAVFAC Atlantic

Attn: Bryan Beck NAVFAC Mid-Atlantic Marine Corps

6506 Hampton Blvd Norfolk, VA 23508

RE:

Draft Expanded Site Investigation Report

MMRP Site UXO-01, ASR #2.23 Former Live Hand Grenade Course Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Dear Mr. Beck:

The Superfund Section of the Division of Waste Management has completed its review of the Draft Expanded Site Investigation Report for MMRP Site UXO-01, Former Live Hand Grenade Course (ASR #2.23). Based on the results of the investigation that has been conducted, we concur with the conclusions and recommendations. Specifically, Section 5.2, states that "Based on the previously presented conclusions, no further action is recommended at Site UXO-01 (ASR #2.23)".

If you have any questions, please contact me at (919) 707-8342.

Sincerely,

Marti Margan Marti Morgan

Environmental Engineer

NCDENR Superfund Section

Cc:

Charity Rychak, MCB Camp Lejeune

Gena Townsend, US EPA

Randy McElveen



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



REGION 4 ATLANTA FEDERAL CENTER 61 FORSYTH STREET, S.W. ATLANTA, GEORGIA 30303-8960

May 31, 2012

NAVFAC Mid-Atlantic Attn: Dave Cleland Code: OPQE3 USMC NC IPT, EV Business Line 6506 Hampton Blvd Norfolk, VA 23508-1273

SUBJ: MCB Camp Lejeune

Draft Expanded Site Investigation Report MMRP UXO-02, Former Unnamed Explosive

Contaminated Range, ASR #2.201

Dear Mr. Cleland:

The Environmental Protection Agency (EPA) has completed its review of the above subject document, dated March 2012. EPA agrees with the recommendation of no further action for the portion of UXO-02 located outside of the Site 69 perimeter fence as it relates to the constituents associated with the Former Unnamed Explosive Range. EPA also understands that the remaining environmental impacts will be assessed under the OU14, Site 69 Feasibility Study.

If there are any questions, I can be reached at (404) 562-8538.

Sincerely,

Gena Townsend

Dity: In-Gena Townsend, o-Superfund Division, Federal Div. cn-Gena Townsend, o-Superfund Division, Federal Div. cn-Gena Townsend, o-Superfund Division, Federal Div. cn-Gena Townsend, out-Environmental Protection Agency, email-townsend gena@epa.gov, c-US Date: 2012.05.31

Gena D. Townsend Senior Project Manager

cc: Randy McElveen, NCDENR Charity Rychak, MCB Camp Lejeune From: Mcelveen, Randy [randy.mcelveen@ncdenr.gov]

Sent: Thursday, October 11, 2012 3:56 PM

To: Keith.LaTorre@CH2M.com; townsend.gena@epamail.epa.gov

Cc: david.t.cleland@navy.mil; Rychak CIV Charity M; Vanture CIV Patricia S;

Matt.Louth@CH2M.com; Kimberly.Henderson@CH2M.com; Tom.Roth@CH2M.com;

jskeean@CH2M.com

Subject: RE: Final ESI MMRP Site UXO-02, Camp Lejeune

October 11, 2012

The NC Superfund Section has received and reviewed the Final ESI Report for MRP Site UXO-02 at IR-Site 69. I have no further comments on this document and concur with the conclusions and recommendations of the report.

Thanks,

Randy McElveen, NC Superfund Section

E-mail correspondence to and from this address may be subject to the North Carolina Public Records Law and may be disclosed to third parties.

W. Randy McElveen Environmental Engineer 217 West Jones Street 1646 Mail Service Center Raleigh, NC 27699-1646

Phone: 919-707-8341, Email: Randy.McElveen@ncdenr.gov

From: Keith.LaTorre@CH2M.com [Keith.LaTorre@CH2M.com]

Sent: Wednesday, October 10, 2012 10:38 AM

To: townsend.gena@epamail.epa.gov; Mcelveen, Randy

Cc: david.t.cleland@navy.mil; charity.rychak@usmc.mil; patricia.vanture@usmc.mil; Matt.Louth@CH2M.com;

<u>Kimberly.Henderson@CH2M.com</u>; <u>Tom.Roth@CH2M.com</u>; <u>jskeean@CH2</u>M.com

Subject: Final ESI MMRP Site UXO-02, Camp Lejeune

Team,

The Final ESI report for MMRP Site UXO-02 (ASR# 2.201) Unnamed Explosive Contaminated Range has been posted to the MCIEast-MCB CAMLEJ Entrise Web Portal in the Project Files folder (within the MMRP sub-folder) and copies have been sent to EPA, NCDENR, and MCIEast-MCB CAMLEJ as documented in the attached letter.

Thank you in advance for your review of this document. If you have any questions please call/email. Thanks!

Keith LaTorre
Project Manager
CH2M HILL
2095 Lakeside Centre Way Suite 200
Knoxville, TN 37922, USA
Direct 865.769.3204
Fax 865.560.2802
Mobile 865.323.3300



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4 ATLANTA FEDERAL CENTER 61 FORSYTH STREET, S.W. ATLANTA, GEORGIA 30303

December 6, 2011

NAVFAC Atlantic Attn: David Cleland NAVFAC Midlant Environmental RPM, Camp Lejeune Marine Corps North Carolina IPT 6506 Hampton Blvd Norfolk, VA 23508-1273

SUBJ: MCB Camp Leieune

Draft Expanded Site Investigation Report

MMRP Site UXO-7 (ASR #2.77)

Former D-6 Practice Hand Grenade Course

Dear Mr. Cleland:

The Environmental Protection Agency (EPA) has completed its review of the above subject document, dated October 2011. Based on the information that is presented in the above subject document and the previous environmental investigations associated with ASR #2.77, EPA agrees with the recommendation of "No further action". This document can be prepared as final.

If there are any questions, I can be reached at (404) 562-8538.

Sincerely,

Gena

Digitally signed by Gena Townsend
Dix criscfena Townsend on Superfund
Dix criscfena Townsend
Dix cr

Senior Project Manager

cc: Martha Morgan, NCDENR Charity Rychak, MCB Camp Lejeune



North Carolina Department of Environment and Natural Resources

Division of Waste Management

Dexter R. Matthews

Director

Dee Freeman Secretary

Beverly Eaves Perdue Governor

November 21, 2011

NAVFAC Atlantic

Attn: Bryan Beck NAVFAC Mid-Atlantic Marine Corps

6506 Hampton Blvd Norfolk, VA 23508

RE:

Draft Expanded Site Investigation Report

MMRP Site UXO-07

Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Dear Mr. Beck:

The Superfund Section of the Division of Waste Management has completed its review of the Draft Expanded Site Investigation Report for MMRP Site UXO-07, Former Practice Hand Grenade Course (ASR #2.77). Based on the results of the investigation that has been conducted, we concur with the conclusions and recommendations. Specifically, Section 5.2, states that "Based on the previously presented conclusions, no further action is recommended at Site UXO-07".

If you have any questions, please contact me at (919) 707-8342.

Sincerely,

Mark

Marti Morgan

Environmental Engineer

NCDENR Superfund Section

Cc: Charity Rychak, MCB Camp Lejeune

Gena Townsend, US EPA

Randy McElveen





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, S.W.
ATLANTA, GEORGIA 30303

November 28, 2011

NAVFAC Atlantic Attn: David Cleland NAVFAC Midlant Environmental RPM, Camp Lejeune Marine Corps North Carolina IPT 6506 Hampton Blvd Norfolk, VA 23508-1273

SUBJ: MCB Camp Lejeune

Draft Preliminary Assessment/Site Investigation Report Site UXO-08 Former Lejeune Cantonment 2.36-Inch Bazooka Range Base CS Chamber & NBC Training Trail ASR #2.182)

And D-7 Gas Chamber (ASR#2.80)

Dear Mr. Cleland:

The Environmental Protection Agency (EPA) has completed its review of the above subject document, dated September, 2011 and has no comments. EPA agrees with the documented recommendation of "no further action" for Site UXO-08 and the identified potential ecological risk will be addressed as part of the upcoming Site 78 Five Year Review. The potential ecological risk, as documented, is not a result of activities associated with Site UXO-08 munitions' activities and is more likely attributed to the industrial activities connected with Site 78. This document can be prepared as final.

If there are any questions, I can be reached at (404) 562-8538.

Sincerely,
Gena
Digitally signed by Gena Townse
No. Con-Gena Townsend, o-Sup.
Division, Federal Facilities Branch
Out-Environmental Protection A;
emill-townsend genal@ep.ap.
Gena D. Townsend
Senior Project Manager

cc: Martha Morgan, NCDENR Charity Rychak, MCB Camp Lejeune



North Carolina Department of Environment and Natural Resources

Division of Waste Management

Dexter R. Matthews

Director

Beverly Eaves Perdue Governor

Dee Freeman Secretary

November 18, 2011

NAVFAC Atlantic

Attn: Bryan Beck NAVFAC Mid-Atlantic Marine Corps

6506 Hampton Blvd Norfolk, VA 23508

RE:

Draft Final Preliminary Assessment/Site Inspection Report

MMRP Site UXO-08

Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Dear Mr. Beck:

The Superfund Section of the Division of Waste Management has completed its review of the Draft Final Preliminary Assessment/Site Inspection Report for MMRP Site UXO-08, Former Lejeune Cantonment 2.36-inch Bazooka Range, Base CS Chamber and NBC Training Trail (ASR#2.182), and D-7 Gas Chamber (ASR #2.80). Based on the results of the investigation that has been conducted, we concur with the conclusions and recommendations. Specifically, Section 7.8, states that "Based on the results from the PA/SI, no further action is recommended for Site UXO-08. No unacceptable human health or ecological risks from historical munitions activities were identified. Potential ecological risks identified in surface water and sediment resulted from historical industrial activities and will be addressed as part of the five year review for Site 78".

If you have any questions, please contact me at (919) 707-8342.

Sincerely,

Marti Magan Marti Morgan

Environmental Engineer

NCDENR Superfund Section

Cc:

Charity Rychak, MCB Camp Lejeune

Gena Townsend, US EPA

Randy McElveen



From: Gena Townsend

To: beth.hartzell@ncdenr.gov; bryan.k.beck@navy.mil; Chris.Bozzini@CH2M.com; david.t.cleland@navy.mil;

<u>Kimberly Henderson@CH2M.com</u>; <u>marcy@rhea.us</u>; <u>martha.morgan@ncdenr.gov</u>; <u>mlouth@ch2m.com</u>; <u>Mark.Pisarcik@shawgrp.com</u>; <u>randy.mcelveen@ncdenr.gov</u>; <u>Lowder CIV Robert A</u>; <u>townsend.gena@epa.gov</u>;

scott@rhea.us; Tim Price; Rychak CIV Charity M; Schultz CIV Nicholas A

Subject: Henderson Pond & UXO-10 (ASR #2.136) EPA comments

Date: Monday, March 12, 2012 10:03:54 AM

Good Morning All,

This is a follow up email to document EPA's review of the Henderson Pond Tech Memo and the no comment response that was discussed at the March 6th meeting. Also EPA has reviewed the Draft ESI for UXO-10 (ASR #2.136) Former D-11A Flame Tank and Flame Thrower Range and have no comments. EPA agrees with the "no further action" recommendation and the "3R" munitions safety awareness training. These documents can be prepared as final.

Gena D. Townsend US EPA 61 Forsyth Street, SW Atlanta, Georgia 30303 Tel. No: (404) 562-8538 Townsend.Gena@epa.gov



North Carolina Department of Environment and Natural Resources

Division of Waste Management

Beverly Eaves Perdue Governor Dexter R. Matthews
Director

Dee Freeman Secretary

February 9, 2012

Mr. Bryan Beck NAVFAC Mid-Atlantic Code: OPCEV NC/Caribbean IPT, EV Business Line 6506 Hampton Blvd Norfolk, VA 23508-1273

RE: Comments on the Draft ESI Report for Site UXO-10, D-11A Flame Tank and Flame Thrower Range

(ASR #2.136)

MCB Camp Lejeune, NC6170022580

Jacksonville, Onslow County, North Carolina

Dear Mr. Beck:

The NC Superfund Section has received and reviewed the Draft Expanded Site Investigation Report for Munitions Response Program (MRP) Site UXO-10, D-11A Flame Tank and Flame Thrower Range (ASR #2.136), dated January 2012 and received for review on February 6, 2012. This investigation work was the subject MRP Site at Camp Lejeune, MCB located in Jacksonville, NC. If you have any questions or comments please contact me at (919) 707-8341.

The NC Superfund Section of NC DENR concurs with the conclusions and recommendations of the ESI Report. The data clearly show that wide spread contamination of soil or groundwater is not present at MRP Site UXO-10. The soil contamination detected is inconsistent and is very close to the calculated background concentrations throughout the area. The same is true for the groundwater contaminants detected in the area and no defined contaminant plume exist in the area. Based on the re-evaluation of the analytical data from the intrusive anomaly investigation no additional sampling and risk screening are necessary and as stated in the Executive Summary of the report, the PA/SI risk Screening found no unacceptable risks to human or ecological receptors from exposure to site media and no High Explosive or consistent Munitions Potentially Presenting an Explosive Hazard were detected at the Site.

Dave Cleland 2/9/2012 Page 2 of 2

If you have any questions or comments, please contact me, at (919) 707-8341 or email

randy.mcelveen@ncdenr.gov

Sincerely,

Randy McElveen

Environmental Engineer NC Superfund Section

Cc: Dave Lown, NC Superfund Section, Electronic only

Charity Rychak, EMD/IR Dave Cleland, NAVFAC

Gena Townsend, EPA Region IV



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4 ATLANTA FEDERAL CENTER 61 FORSYTH STREET, S.W. ATLANTA, GEORGIA 30303

December 7, 2011

NAVFAC Atlantic Attn: David Cleland NAVFAC Midlant Environmental RPM, Camp Lejeune Marine Corps North Carolina IPT 6506 Hampton Blvd Norfolk, VA 23508-1273

SUBJ: MCB Camp Lejeune

Draft Expanded Site Investigation Report

MMRP Site UXO-11 (ASR #2.81)

Former B-5 Practice Hand Grenade Course

Dear Mr. Cleland:

The Environmental Protection Agency (EPA) has completed its review of the above subject document, dated October 2011. The expanded site investigation was conducted to further evaluate the environmental impact of constituents identified in the Preliminary Assessment/Site Investigation Report. The data, as presented in the above subject report, indentifies that there are no unacceptable risk to human health and the environment from potential exposure to site media. EPA agrees with the recommendation of "No Further Action" for UXO-11. This document can be prepared as final.

If there are any questions, I can be reached at (404) 562-8538.

Sincerely,

Gena Townsend

Digitally signed by Gena Townsend

Div. cn=Gena Townsend, o=Superfund

Division, Federal Facilities Branch,

Du=Environmental Protection Agency,
email=townsend.gena@epa.gov, c-10

Date: 2011.12.07 09.22:13-05001

Gena D. Townsend Senior Project Manager

cc: Martha Morgan, NCDENR Charity Rychak, MCB Camp Lejeune



North Carolina Department of Environment and Natural Resources

Division of Waste Management

Dexter R. Matthews

Director

Dee Freeman Secretary

Beverly Eaves Perdue Governor

November 21, 2011

NAVFAC Atlantic Attn: Bryan Beck NAVFAC Mid-Atlantic Marine Corps 6506 Hampton Blvd Norfolk, VA 23508

RE:

Draft Expanded Site Investigation Report

MMRP Site UXO-11

Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Dear Mr. Beck:

The Superfund Section of the Division of Waste Management has completed its review of the Draft Expanded Site Investigation Report for MMRP Site UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81). Based on the results of the investigation that has been conducted, we concur with the conclusions and recommendations. Specifically, Section 7.2, states that "Based on the previously presented conclusions, no further action is recommended at Site UXO-11".

If you have any questions, please contact me at (919) 707-8342.

Sincerely,

Mart

Marti Morgan

Environmental Engineer

NCDENR Superfund Section

Cc: Charity Rychak, MCB Camp Lejeune

Gena Townsend, US EPA

Randy McElveen



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY



REGION 4 ATLANTA FEDERAL CENTER 61 FORSYTH STREET, S.W. ATLANTA, GEORGIA 30303-8960

February 16, 2012

NAVFAC Atlantic Attn: Dave Cleland NAVFAC Midlant Environmental RPM, Camp Lejeune Marine Corps North Carolina IPT 6506 Hampton Blvd Norfolk, VA 23508-1273

SUBJ: MCB Camp Lejeune Draft Final Expanded Site Investigation MMRP UXO-17 Former Firing Position 2 (ASR #2.212)

Dear Mr. Cleland:

The Environmental Protection Agency (EPA) has completed its review of the above subject document, dated November, 2011 and agrees with the documented recommendations. EPA acknowledges the findings of no unacceptable human health or ecological risk and agrees with the no additional environmental or munitions and explosives of concern investigation. This agreement is supported by the designated future land use as an above grade expansion for the base landfill. However, if there is a change in the future designated land use, additional sampling may be required.

If there are any questions, I can be reached at (404) 562-8538.

Sincerely,

Gena

Digitally signed by Gena Townsend DN: cn=Gena Townsend, o=Superfund Division, Federal Facilities Branch, Townsend under 2012.02.16 10:19:53 -05'00'

Gena D. Townsend Senior Project Manager

cc: Martha Morgan, NCDENR Charity Rychak, MCB Camp Lejeune



North Carolina Department of Environment and Natural Resources

Division of Waste Management

Beverly Eaves Perdue Governor

Dexter R. Matthews
Director

Dee Freeman Secretary

January 19, 2012

NAVFAC Atlantic

Attn: Bryan Beck NAVFAC Mid-Atlantic Marine Corps

6506 Hampton Blvd Norfolk, VA 23508

RE:

Draft Preliminary Assessment/Site Inspection Report

MMRP Site UXO-17, Former Firing Position 2

Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Dear Mr. Beck:

The Superfund Section of the Division of Waste Management has completed its review of the Draft Preliminary Assessment/Site Inspection Report for MMRP Site UXO-17, Former Firing Position 2, ASR# 2.212. Based on the results of the investigation that has been conducted, we concur with the conclusions and recommendations. Specifically, Section 7.2, states that "No additional environmental or MEC investigation is recommended at Site UXO-17, Former Firing Position 2, based on the following:

- No unacceptable human health or ecological risks were identified from exposure to site media;
- Intrusive anomaly investigations were completed over 100% of the 4-acre firing position and the risk of contact with MEC was significantly reduced;
- Intrusive anomaly investigations were completed over 9% of the surrounding 12-acre area and no MEC items were encountered; and
- It is anticipated that the site will be used as an above grade expansion area for the Base landfill, potentially covering any remaining subsurface debris.

Prior to MILCON proceeding at the site, it is recommended that all site personnel conducting subsurface/intrusive activities receive "3R" munitions awareness training for recognizing, retreating, and reporting potential MEC hazards. It is also recommended that on-call construction support be provided from MCB CamLej Explosive Ordnance Disposal personnel or a qualified UXO contractor for inspection and disposal of suspected MEC/MPPEH that may be unearthed."

If you have any questions, please contact me at (919) 707-8342.

Sincerely,

Marti Morgan

Environmental Engineer NCDENR Superfund Section

Cc:

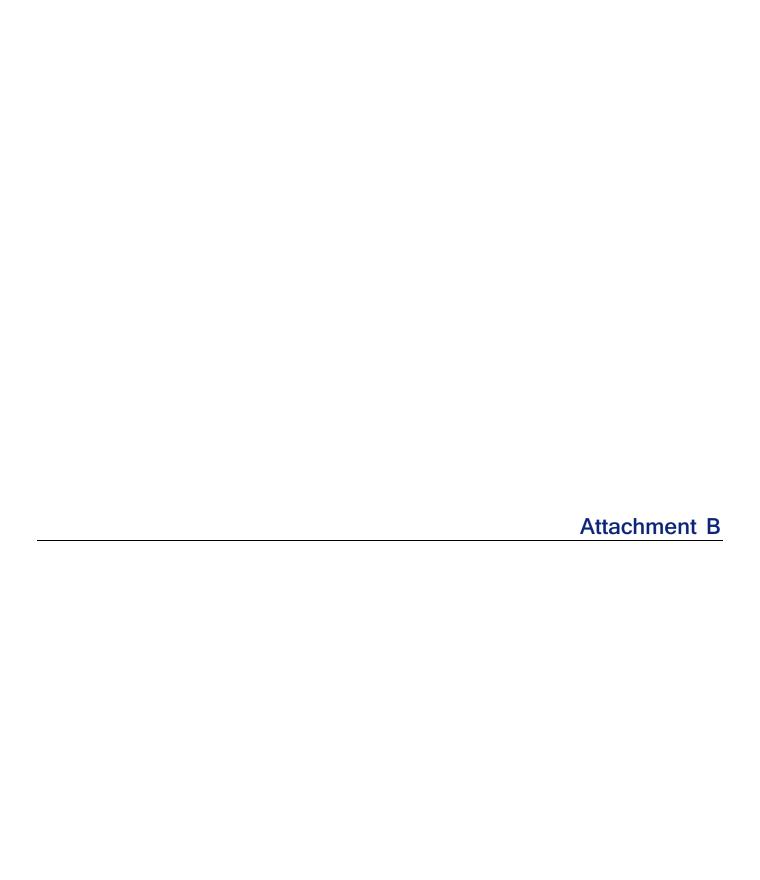
Charity Rychak, MCB Camp Lejeune

Gena Townsend, US EPA

Randy McElveen

North Carolina

Naturally



Human Health Risk Screening and Assessment Methodology

The Human Health Risk Screenings (HHRS) were conducted in three steps using a risk ratio technique (Navy, 2000) as follows.

Step 1. The maximum detected constituent concentration for each media was screened against the following criteria. Note that screening criteria were current at the time that the reports were submitted and may not reflect current standards:

- USEPA-adjusted residential RSLs (soil), tap water RSLs (groundwater), (USEPA, 2008, 2009, 2010, 2011), or other human health risk screening levels (if appropriate)
- Two times the mean surface and subsurface soil and groundwater background concentration (for metals) (Baker, 2002)
- Surface water data were compared to RSLs only when the North Carolina Water Quality Standards for human health and water supply (if available) did not exist for a constituent.

Step 2. If the maximum detected concentration exceeded the screening criteria the constituent was retained as a chemical of potential concern (COPC) and a corresponding risk level was calculated in Step 2 using the following equation:

corresponding risk level = $\frac{\text{concentration} \times \text{acceptable risk level}}{\text{RSL}}$

The acceptable risk level is 1 for noncarcinogens and 10⁻⁶ for carcinogens. The corresponding risk levels for each media were summed to calculate the hazard index (HI) for noncarcinogens and the cancer risk for carcinogens. An HI for each target organ/effect was also calculated. If any target organ/effect HI exceeded 0.5 or cancer risk exceeds 5×10-5, the chemicals corresponding to these values were retained as COPCs and carried forward to Step 3.

Step 3. Step 3 follows the same procedure as Step 2 with one exception: a corresponding risk level for each COPC was calculated using the 95 percent upper confidence limit (UCL) in place of the maximum concentration, if more than 5 samples were available for that media. If fewer than five samples were available, the maximum concentration was used. The ProUCL software that was most current at the time of the screening (USEPA, 2007, 2009, 2010) was used to calculate the 95 percent UCL.

For sites where COPCs were identified based on the HHRS, a human health risk assessment (HHRA) was conducted. Guidance documents used for preparing the risk assessment include RAGS Part A (USEPA, 1989), RAGS Part D (USEPA, 2001), RAGS Part E (USEPA, 2004), and USEPA Region IV Supplemental Guidance to RAGS: Region IV Bulletins (USEPA, 2000). The primary objective of the HHRA was to assess the health risks associated with exposure to site media with COPCs identified in the Phase I risk screening under current site conditions. The risk assessment is comprised of the following components:

- **Identification of COPCs**—Identification of the chemicals found onsite and selection of the COPCs. COPCs are the focus of the subsequent evaluation in the risk assessment.
- **Exposure Assessment**—Identification of the potential pathways of human exposure, and estimation of the magnitude, frequency, and duration of these exposures.
- **Toxicity Assessment**—Compilation of the toxicity values used for developing numerical risk estimates for the COPCs.
- **Risk Characterization**—Integration of the results of the exposure and toxicity assessments to develop numerical estimates of health risks.
- Uncertainty Assessment—Identification and discussion of sources of uncertainty in the risk assessment.

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USEPA. 2011. Regional Screening Levels for Chemicals Contaminants at Superfund Sites. June. (September 2008, December 2009, May 2010) http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/index.htm

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Ecological Risk Screening Methodology

The Ecological Screenings (ERS) were conducted as follows.

For each medium (subsurface soil, groundwater, sediment, and/or surface water), the maximum and average concentrations are presented along with representative Ecological Screening Values (ESVs) intended to be protective of ecological receptors. Hazard Quotients (HQs) were calculated by dividing these statistics by the ESVs.

The following screening criteria were selected as ESVs. Note that screening criteria were current at the time that the reports were submitted and may not reflect current standards:

- For soil, Region 4 values (EPA, 2001) were selected when there was no value for the EPA Ecological Soil Screening Levels (EcoSSL) (EPA, 2008, 2009, 2011).
- For groundwater, the Region 4 values were selected when there was no value for the National Recommended Water Quality Criteria (NRWQC) (EPA, 2006, 2009). Marine or freshwater ESVs were also used to screen groundwater concentrations and were selected based on nearby water bodies.
- For surface water, Region 4 values were selected when there was no value for the NRWQC was preferentially selected over the Region 4 value. North Carolina Surface Water Quality Standards (NCDENR, 2007) were also used for some screenings.
- For sediment, EPA Region 4 values were selected.

When ESVs were not available using the selected hierarchy above, supplemental ESVs were identified as available. A base background study was conducted at MCB Camp Lejeune in June and July 2000 (Baker, 2001). As part of the ERS, subsurface soil and groundwater background concentrations were compared to site-specific media concentrations. Additional lines of evidence in the evaluation include the frequency of detection, frequency of exceedance, magnitude of exceedance, and identification of potential laboratory contaminants.

References

Baker Environmental, Inc. 2001. Final Base Background Study (Soil), Marine Corps Base Camp Lejeune, North Carolina. Prepared for the Naval Facilities Engineering Command, Atlantic Division, Norfolk, Virginia. April 2001.

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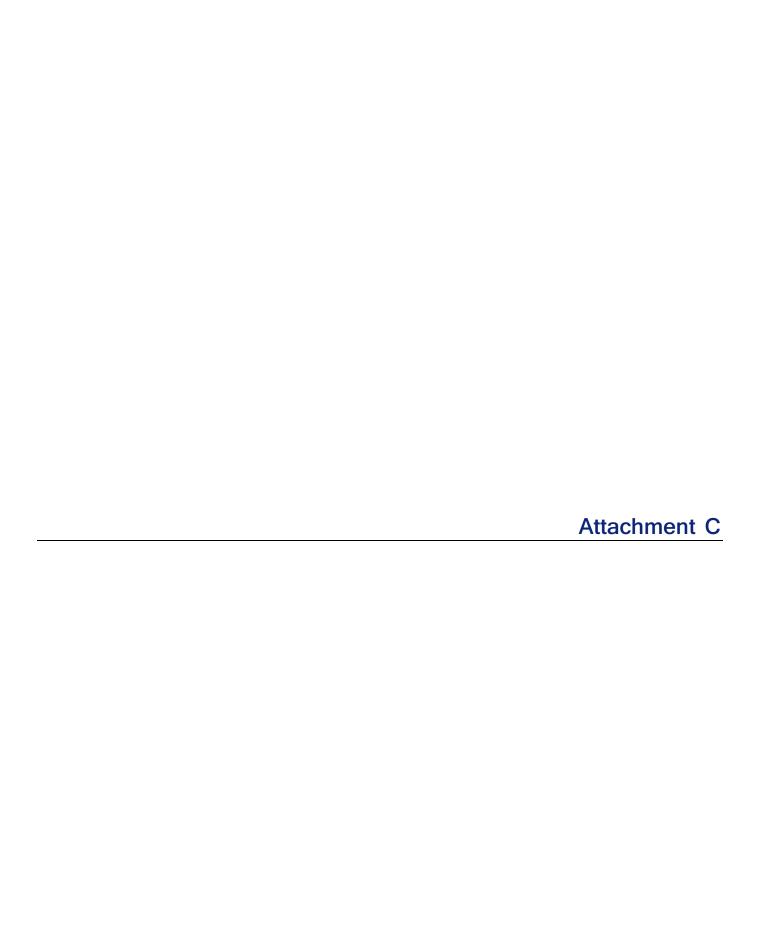


TABLE 6-6
Summary of RME Cancer Risks and Hazard Indices
Hadnot Point Construction Area
HPCA, POIA, and FC PA/SI Report
MCB CamLej
North Carolina

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1
Current/Future	Sediment	Ingestion	2.6E-06			Arsenic	0.016	
Industrial Worker	Codimon	Dermal Contact	4.2E-06			Arsenic, Chromium	0.020	
		Inhalation	N/A				N/A	
		Total	6.7E-06			Arsenic, Chromium	0.036	
	Surface Soil	Ingestion	1.1E-05			Benzo(a)pyrene, Arsenic, Chromium	0.046	
	Exposure Unit 3	Dermal Contact	3.7E-06			Benzo(a)pyrene, Arsenic	0.0094	
		Inhalation	7.3E-08				0.00017	
		Total	1.5E-05			Benzo(a)pyrene, Arsenic, Chromium	0.056	
	Surface Soil	Ingestion	8.1E-06			Benzo(a)pyrene, Chromium	0.0095	
	Exposure Unit 4	Dermal Contact	5.2E-06			Benzo(a)pyrene	0.0021	
		Inhalation	5.7E-08				0.000039	
		Total	1.3E-05			Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Arsenic, Chromium	0.012	
	Surface Soil	Ingestion	7.6E-06			Benzo(a)pyrene, Arsenic, Chromium	0.015	
	Exposure Unit 5	Dermal Contact	4.0E-06			Benzo(a)pyrene	0.0033	
		Inhalation	6.9E-08				0.000060	
		Total	1.2E-05			Benzo(a)pyrene, Dibenz(a,h)antracene, Arsenic, Chromium	0.019	
	Surface Soil	Ingestion	2.3E-05		Benzo(a)pyrene	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Chromium	0.0063	
	Exposure Unit 7/8	Dermal Contact	1.9E-05		Benzo(a)pyrene	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene	0.0015	
		Inhalation	4.9E-08				0.000027	
		Total	4.2E-05			Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Chromium	0.0078	
	All Media*	Total	4.9E-05	<u> </u>			0.092	

TABLE 6-6
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North Carolina

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1
Current/Future	Sediment	Ingestion	1.1E-05		Arsenic		0.071	
respasser/Visitor Adult		Dermal Contact	2.3E-05		Arsenic	Chromium	0.14	
reopasson visitor ridait		Inhalation	N/A		7.11.00.11.0	- Childring III	N/A	
		Total	3.5E-05		Arsenic	Chromium	0.21	
	Surface Soil	Ingestion	1.9E-06			Arsenic	0.0083	
	Exposure Unit 3	Dermal Contact	3.8E-07				0.0010	
	Exposure or in o	Inhalation	3.2E-09				0.0000075	
		Total	2.3E-06			Arsenic	0.0093	
	Surface Soil	Ingestion	1.4E-06			, weenie	0.0017	
	Exposure Unit 4	Dermal Contact	5.4E-07				0.00023	
		Inhalation	2.5E-09				0.0000018	
		Total	1.9E-06				0.0019	
	Surface Soil	Ingestion	1.3E-06			†	0.0013	
	Exposure Unit 5	Dermal Contact	4.1E-07			 	0.00036	
	Exposure or in a	Inhalation	3.0E-09				0.0000027	
		Total	1.7E-06				0.0031	
	Surface Soil	Ingestion	4.1E-06			Benzo(a)pyrene	0.0001	
	Exposure Unit 7/8	Dermal Contact	2.0E-06			Benzo(a)pyrene	0.00016	
	Exposure offic 170	Inhalation	2.1E-09			Benzo(a)pyrene	0.000012	
		Total	6.0E-06			Benzo(a)pyrene, Debenz(a,h)anthracene	0.0013	
	All Media*	Total	4.1E-05				0.22	
Current/Future	Sediment	Ingestion	7.2E-06			Arsenic	0.11	
respasser/Visitor Youth		Dermal Contact	1.1E-05		Arsenic		0.16	
		Inhalation	N/A				N/A	
		Total	1.8E-05		Arsenic	Chromium	0.27	
	Surface Soil	Ingestion	1.2E-06				0.013	
	Exposure Unit 3	Dermal Contact	2.6E-07				0.0017	
		Inhalation	1.3E-09				0.0000075	
		Total	1.5E-06				0.015	
	Surface Soil	Ingestion	9.1E-07				0.0027	
	Exposure Unit 4	Dermal Contact	3.7E-07				0.00038	
		Inhalation	1.0E-09				0.0000018	
		Total	1.3E-06				0.0031	
	Surface Soil	Ingestion	8.5E-07				0.0043	
	Exposure Unit 5	Dermal Contact	2.8E-07				0.00060	
		Inhalation	1.2E-09				0.0000027	
		Total	1.1E-06				0.0049	
	Surface Soil	Ingestion	2.6E-06			Benzo(a)pyrene	0.0018	
	Exposure Unit 7/8	Dermal Contact	1.3E-06			1777	0.00026	
		Inhalation	8.8E-10				0.0000012	
		Total	4.0E-06			Benzo(a)pyrene	0.0020	
	All Media*	Total	2.2E-05		1	1.71.7	0.29	

TABLE 6-6
Summary of RME Cancer Risks and Hazard Indices
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Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1
Current/Future	Sediment	Ingestion	2.6E-05		Arsenic	Chromium	0.66	
respasser/Visitor Child		Dermal Contact	4.5E-06			Arsenic	0.11	
		Inhalation	N/A				N/A	
		Total	3.0E-05		Arsenic	Chromium	0.77	
	Surface Soil	Ingestion	4.5E-06			Arsenic	0.077	
	Exposure Unit 3	Dermal Contact	6.3E-07				0.0067	
		Inhalation	7.9E-10				0.0000075	
		Total	5.1E-06			Arsenic	0.084	
	Surface Soil	Ingestion	3.3E-06			Benzo(a)pyrene	0.016	
	Exposure Unit 4	Dermal Contact	8.9E-07				0.0015	
		Inhalation	6.2E-10				0.0000018	
		Total	4.2E-06			Benzo(a)pyrene	0.018	
	Surface Soil	Ingestion	3.1E-06				0.026	
	Exposure Unit 5	Dermal Contact	6.8E-07				0.0024	
		Inhalation	7.5E-10				0.0000027	
		Total	3.7E-06				0.028	
	Surface Soil	Ingestion	9.5E-06			Benzo(a)pyrene, Dibenz(a,h)anthracene	0.011	
	Exposure Unit 7/8	Dermal Contact	3.2E-06			Benzo(a)pyrene	0.0010	
		Inhalation	5.3E-10				0.0000012	
		Total	1.3E-05			Benzo(a)pyrene, Dibenz(a,h)anthracene	0.012	
	All Media*	Total	4.3E-05				0.86	

TABLE 6-6
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Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1
uture	Groundwater Group 1	Ingestion	N/A				8.4	Benzene, Xylene, Arsenic
esident Adult		Dermal Contact	N/A				2.9	
		Inhalation	N/A				10	Xylene, Naphthalene
		Total	N/A				22	Benzene,Toluene, Xylene, 2- Methylnaphthalene, Naphthalene, Arsenic
	Groundwater Group 2	Ingestion	N/A				6.5	Arsenic
		Dermal Contact	N/A				0.061	
		Inhalation	N/A				N/A	
		Total	N/A				6.6	Arsenic
	Groundwater Group 3	Ingestion	N/A				4.8	Vinyl chloride, cis-1,2- Dichloroethene, Arsenic
		Dermal Contact	N/A				0.32	
		Inhalation	N/A				0.21	
		Total	N/A				5.3	Vinyl chloride, cis-1,2- Dichloroethene, Arsenic
	Groundwater Group 4	Ingestion	N/A				0.71	
	·	Dermal Contact	N/A				0.035	
		Inhalation	N/A				0.00041	
		Total	N/A				0.74	
	Surface Soil	Ingestion	N/A				0.065	
	Exposure Unit 3	Dermal Contact	N/A				0.0080	
	·	Inhalation	N/A				0.00070	
		Total	N/A				0.073	
	Surface Soil	Ingestion	N/A				0.013	
	Exposure Unit 4	Dermal Contact	N/A				0.0018	
	·	Inhalation	N/A				0.00016	
		Total	N/A				0.015	
	Surface Soil	Ingestion	N/A				0.021	
	Exposure Unit 5	Dermal Contact	N/A				0.0028	
	1 '	Inhalation	N/A				0.00025	
		Total	N/A				0.024	
	Surface Soil	Ingestion	N/A				0.0088	İ
	Exposure Unit 7/8	Dermal Contact	N/A				0.0012	
	1 '	Inhalation	N/A				0.00011	
		Total	N/A				0.010	İ
	All Media*	Total	N/A		İ	İ	22	

TABLE 6-6
Summary of RME Cancer Risks and Hazard Indices
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North Carolina

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1
Future	Groundwater Group 1	Ingestion	N/A				20	Benzene, Toluene, Xylene, Napthalene, Arsenic
Resident Child		Dermal Contact	N/A				5.9	Xylene, 2-Methylnaphthalene
		Inhalation	N/A				25	Benzene, Xylene, Naphthalene
		Total	N/A				50	Benzene, Ethylbenzene, Toluene, Xylene, 2-Methylnaphthalene, Naphthalene, Arsenic
	Groundwater Group 2	Ingestion	N/A				15	Arsenic
		Dermal Contact	N/A				0.18	
		Inhalation	N/A				N/A	
		Total	N/A				15	Arsenic
	Groundwater Group 3	Ingestion	N/A				11	Vinyl chloride, cis-1,2- Dichloroethene, Arsenic
		Dermal Contact	N/A				0.16	
		Inhalation	N/A				0.53	
		Total	N/A				12	Vinyl chloride, cis-1,2- Dichloroethene, Arsenic
	Groundwater Group 4	Ingestion	N/A				1.7	Antimony
		Dermal Contact	N/A				0.092	
		Inhalation	N/A				0.087	
		Total	N/A				1.8	Antimony
	Surface Soil	Ingestion	N/A				0.60	
	Exposure Unit 3	Dermal Contact	N/A				0.052	
		Inhalation	N/A				0.00070	
		Total	N/A				0.66	
	Surface Soil	Ingestion	N/A				0.12	
	Exposure Unit 4	Dermal Contact	N/A				0.012	
		Inhalation	N/A				0.00016	
		Total	N/A				0.14	
	Surface Soil	Ingestion	N/A				0.20	
	Exposure Unit 5	Dermal Contact	N/A				0.018	
		Inhalation	N/A				0.00025	
		Total	N/A				0.22	
	Surface Soil	Ingestion	N/A				0.082	
	Exposure Unit 7/8	Dermal Contact	N/A				0.0080	
		Inhalation	N/A				0.00011	
		Total	N/A				0.090	
	All Media	Total	N/A				51	

TABLE 6-6
Summary of RME Cancer Risks and Hazard Indices
Hadnot Point Construction Area
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North Carolina

					Chemicals with Cancer	Chemicals with Cancer	Hazard	Chemicals with HI>1
eceptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Risks >10 ⁻⁵ and <10 ⁻⁴	Risks >10 ⁻⁶ and <10 ⁻⁵	Index	
iture	Groundwater Group 1	Ingestion	1.2E-03	Benzene, Ethylbenzene, Arsenic			N/A	
esident Child/Adult		Dermal Contact	9.1E-03	Benzene, Ethylbenzene, Arsenic			N/A	
		Inhalation	4.9E-04	Ethylbenzene, Naphthalene	Benzene		N/A	
		Total	1.1E-02	Benzene, Ethylbenzene, Naphthalene, Arsenic			N/A	
	Groundwater Group 2	Ingestion	1.6E-03	Arsenic	Chromium		N/A	
		Dermal Contact	1.4E-03	Arsenic, Chromium			N/A	
		Inhalation	N/A				N/A	
		Total	3.0E-03	Arsenic, Chromium			N/A	
	Groundwater Group 3	Ingestion	2.3E-03	Vinyl chloride, Arsenic	1,1-Dichloroethane, Benzene	1,2-Dichloroethane, Trichoroethene, bis(2- Ethylhexyl)phthalate	N/A	
		Dermal Contact	6.6E-04	Benzene	1,1-Dichloroethane, Trichloroethene, Vinyl chloride, bis(2- Ethylhexyl)phthalate, Arsenic	1,2-Dichloroethane	N/A	
		Inhalation	5.6E-05		Benzene, Vinyl chloride	1,1-Dichloroethane, Trichloroethene	N/A	
		Total	3.1E-03	Benzene, Vinyl chloride, Arsenic	1,1-Dichloroethane, Ethylbenzene, Trichloroethene, bis(2- Ethylhexyl)phthalate	1,2-Dichloroethane	N/A	
	Groundwater Group 4	Ingestion	4.6E-05		Arsenic	Vinyl chloride, bis(2- Ethylhexyl)phthalate	N/A	
		Dermal Contact	1.0E-04		bis(2-Ethylhexyl)phthalate	Trichloroethene, Arsenic	N/A	
		Inhalation	9.0E-07			, , , , , , , , , , , , , , , , , , , ,	N/A	
		Total	1.5E-04				N/A	
	Surface Soil	Ingestion	1.1E-04		Benzo(a)pyrene, Arsenic, Chromium	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene	N/A	
	Exposure Unit 3	Dermal Contact	2.3E-05			Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Arsenic, Chromium	N/A	
		Inhalation	9.1E-07				N/A	
		Total	1.4E-04		Benzo(a)pyrene, Arsenic, Chromium	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene	N/A	
	Surface Soil	Ingestion	1.5E-04		Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Chromium	Benzo(k)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Arsenic	N/A	
	Exposure Unit 4	Dermal Contact	3.9E-05		Benzo(a)pyrene	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene	N/A	
		Inhalation	6.8E-09				N/A	
		Total	1.9E-04		Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Chromium	Benzo(k)fluoranthe, Indeno(1,2,3-cd)pyrene, Arsenic	N/A	

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	Surface Soil	Ingestion	1.2E-04		Benzo(a)pyrene, Dibenz(a,h)anthracene, Chromium	Benzo(a)anthracene, Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene, Arsenic	N/A	
	Exposure Unit 5	Dermal Contact	3.2E-05		Benzo(a)pyrene	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Chromium	N/A	
		Inhalation	3.9E-08				N/A	
		Total	1.5E-04		Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Chromium	Benzo(a)anthracene, Indeno(1,2,3-cd)pyrene, Arsenic	N/A	
	Surface Soil	Ingestion	4.6E-04	Benzo(a)pyrene	Benzo(a)anthracene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Chromium	Benzo(k)fluoranthene, Arsenic	N/A	
	Exposure Unit 7/8	Dermal Contact	1.6E-04		Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(ah,)anthracene	Indeno(1,2,3-cd)pyrene	N/A	
		Inhalation	6.2E-07				N/A	
		Total	6.2E-04	Benzo(a)pyrene, Debenz(a,h)anthracene	Benzo(a)anthracene, Benzo(b)fluoranthene, Indeno(1,2,3-cd)pyrene, Chromium	Benzo(k)fluoranthene, Arsenic	N/A	
İ	All Media*	Total	1.1E-02				N/A	

TABLE 6-6
Summary of RME Cancer Risks and Hazard Indices
Hadnot Point Construction Area
HPCA, POIA, and FC PA/SI Report
MCB CamLej
North Carolina

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1
Future	Sediment	Ingestion	3.1E-06			Arsenic	0.46	
Construction Worker		Dermal Contact	7.8E-07				0.11	
		Inhalation	N/A				N/A	
		Total	3.8E-06			Arsenic	0.57	
	Groundwater Group 1	Ingestion	N/A				N/A	
		Dermal Contact	7.7E-08				0.059	
		Inhalation	7.5E-09				0.0041	
		Total	8.5E-08				0.063	
	Groundwater Group 2	Ingestion	N/A				N/A	
		Dermal Contact	1.5E-07				0.0070	
		Inhalation	N/A				N/A	
		Total	1.5E-07				0.0070	
	Groundwater Group 3	Ingestion	N/A				N/A	
		Dermal Contact	1.7E-08				0.0028	
		Inhalation	2.4E-09				0.00036	
		Total	1.9E-08				0.0032	
	Groundwater Group 4	Ingestion	N/A				N/A	
		Dermal Contact	4.7E-09				0.0045	
		Inhalation	3.5E-11				0.000017	
		Total	4.7E-09				0.0046	
	Surface Soil	Ingestion	2.1E-06			Arsenic	0.20	
	Exposure Unit 3	Dermal Contact	1.5E-07				0.0084	
		Inhalation	2.9E-09				0.00017	
		Total	2.3E-06			Arsenic	0.21	
	Surface Soil	Ingestion	1.6E-06				0.031	
	Exposure Unit 4	Dermal Contact	1.9E-07				0.0013	
		Inhalation	2.3E-09				0.000039	
		Total	1.8E-06				0.032	
	Surface Soil	Ingestion	1.5E-06				0.055	
	Exposure Unit 5	Dermal Contact	1.6E-07				0.0023	
		Inhalation	2.8E-09				0.000060	
		Total	1.6E-06				0.058	
	Surface Soil	Ingestion	4.5E-06			Benzo(a)pyrene	0.017	
	Exposure Unit 7/8	Dermal Contact	7.5E-07		_		0.00075	
		Inhalation	2.0E-09				0.000027	
		Total	5.3E-06			Benzo(a)pyrene, Dibenz(a,h)anthracene	0.018	
	All Media*	Total	9.1E-06				0.85	

^{*}Total Receptor Risks and Hazards Across All Media are based on the addition of the risks and hazards for sediment, the maximum risks and hazards for groundwater (Residents, Non-cancer risk - Group 1; Construction Worker, Cancer risk - Group 3, and Construction Worker, Non-cancer risk - Group 1), and the maximum risks and hazards for surface soil (All receptors, Cancer risk - Exposure Units 7/8 combined; Non-cancer hazard - Exposure Unit 3).

TABLE 6-7 Summary of CTE Cancer Risks and Hazard Indices Hadnot Point Construction Area HPCA, POIA, and FC PA/SI Report MCB CamLej North Carolina

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1
Future	Groundwater Group 1	Ingestion	N/A				4.0	Arsenic
Resident Adult	Creananater Greap :	Dermal Contact	N/A			1	1.3	1
rtoolaont / tault		Inhalation	N/A				1.5	
		IIIIaiation	19/75				1.0	Benzene, Xylene, Naphthalene,
		Total	N/A				6.7	Arsenic
	Groundwater Group 2	Ingestion	N/A				3.0	Arsenic
		Dermal Contact	N/A				0.018	
		Inhalation	N/A				N/A	
		Total	N/A				3.1	Arsenic
	Groundwater Group 3	Ingestion	N/A				2.2	
		Dermal Contact	N/A				0.17	
		Inhalation	N/A				0.031	
		Total	N/A				2.4	
	Groundwater Group 4	Ingestion	N/A				0.33	
	Groundwater Group 4	Dermal Contact	N/A				0.012	
			N/A		-		5.1E-03	
		Inhalation	N/A N/A				0.35	
		Total	N/A				0.35	Benzene, Toluene, Xylene,
Future	Groundwater Group 1	Ingestion	N/A				13	Napthalene, Arsenic
Resident Child	Groundwater Group 1		N/A		-		2.5	Napitialetie, Alseriic
Resident Child		Dermal Contact Inhalation	N/A N/A				7.1	Xylene, Naphthalene
		innaiation	IN/A				7.1	Benzene, Toluene, Xylene, 2-
								Methylnaphthalene, Napthalene,
		Total	N/A				23	Arsenic
	Groundwater Group 2	Ingestion	N/A				10	Arsenic
	Greatianater Greap 2	Dermal Contact	N/A			1	0.040	1
		Inhalation	N/A			1	N/A	
		Total	N/A			1	10	Arsenic
		Total	IN/A				10	Vinyl chloride, cis-1,2-Dichloroethene
	Groundwater Group 3	Ingestion	N/A				7.5	Arsenic
		Dermal Contact	N/A				0.34	
		Inhalation	N/A				0.14	
		minalation	14//			1	0.14	Vinyl chloride, cis-1,2-
		Total	N/A				8.0	Dichloroethene, Arsenic,
	Groundwater Group 4	Ingestion	N/A				1.1	
		Dermal Contact	N/A				0.026	
		Inhalation	N/A				0.024	
		Total	N/A				1.2	
uture	Groundwater Group 1	Ingestion	4.3E-04	Arsenic	Benzene, Ethylbenzene		N/A	
Resident Child/Adult	Groundwater Group 1	Dermal Contact		Benzene, Ethylbenzene	Arsenic		N/A	
Vesident Onlid/Addit		Dermai Contact	Z.ZL-03	Benzene, Eurybenzene	Benzene, Ethtlbenzene,		IN/A	
		Inhalation	9.4E-05		Naphthalene		N/A	
				Benzene, Ethylbenzene,				
		Total	2.8E-03	Arsenic	Naphthalene		N/A	
	Groundwater Group 2	Ingestion	5.8E-04	Arsenic	Chromium		N/A	
	<u> </u>	Dermal Contact	2.3E-04	Chromium	Arsenic		N/A	
		Inhalation	N/A				N/A	
		Total	8.1E-04	Arsenic, Chromium			N/A	
				,		1,1-Dicnioroetnane,	i .	
	Groundwater Group 3	Ingestion	8.3E-04	Vinyl chloride, Arsenic	Benzene	Trichloroethene	N/A	

TABLE 6-7 Summary of CTE Cancer Risks and Hazard Indices Hadnot Point Construction Area HPCA, POIA, and FC PA/SI Report MCB CamLej North Carolina

				Chemicals with Cancer	Chemicals with Cancer	Chemicals with Cancer	Hazard	
eceptor	Media	Exposure Route	Cancer Risk	Risks >10 ⁻⁴	Risks >10 ⁻⁵ and <10 ⁻⁴	Risks >10 ⁻⁶ and <10 ⁻⁵	Index	Chemicals with HI>1
-					Benzene, Trichloroethene,1,1-			
					Dichloroethane, bis(2-			
		Dermal Contact	1.3E-03	Vinyl chloride	ethylhexyl)phthalate,Arsenic	Ethylbenzene	N/A	
		Inhalation	6.6E-06			Benzene,V inyl Chloride	N/A	
					1,1,-Dichloroethane, Benzene,			
					Trichloroethene, bis(2-	1,2-Dichloroethane,		
		Total	2.1E-03	Vinyl chloride, Arsenic	Ethylhexyl)phthalate	Ethylbenzene	N/A	
	Groundwater Group 4	Ingestion	1.6E-05		Arsenic	Vinyl chloride	N/A	
		Dermal Contact	2.7E-05		bis(2-Ethylhexyl)phthalate	Vinyl chloride, Arsenic	N/A	
		Inhalation	3.1E-07				N/A	
					bis(2-Ethylhexyl)phthalate,	1		
		Total	4.3E-05		Arsenic	Trichloroethene, Vinyl chloride	N/A	
						Benzo(a)antnracene,Benzo(b)		
						fluoranthene,		
		l			Benzo(a)pyrene, Arsenic,	Dibenz(a,h)anthracene,		
	Surface Soil	Ingestion	1.7E-05		Chromium	Indeno(1,2,3-cd)pyrene Benzo(a)pyrene,	N/A	
	Exposure Unit 3					Benzo(a)pyrene, Benzo(b)fluoranthene,		
						Dibenz(a,h)anthracene,		
		Dermal Contact	1.4E-06			Arsenic	N/A	
		Inhalation	3.1E-07	Chromium	+	Arsenic	N/A	
		innaiation	3.1E-07	Chromium		Benzo(a)antnracene,Benzo(b)	N/A	
						fluoranthene,		
						Dibenz(a,h)anthracene,		
		Total	1.8E-05	Chromium	Benzo(a)pyrene, Arsenic	Indeno(1,2,3-cd)pyrene	N/A	
						Benzo(a)pyrene,		
	Surface Soil	Ingestion	5.6E-05		Chromium	Dibenz(a,h)anthracene	N/A	
	Exposure Unit 4	Dermal Contact	1.3E-06				N/A	
	• • • • • • • • • • • • • • • • • • • •					Benzo(a)pyrene,		
		Total	5.7E-05		Chromium	Dibenz(a,h)anthracene	N/A	
						Benzo(a)pyrene,		
						Benzo(b)fluoranthene,		
	Surface Soil	Ingestion	2.3E-05		Chromium	Dibenz(a,h)anthracene,	N/A	
	Exposure Unit 5	Dermal Contact	2.1E-06				N/A	
						Benzo(a)pyrene,		
					Oh	Benzo(b)fluoranthene,		
		Total	2.5E-05		Chromium	Dibenz(a,h)anthracene, Benzo(a)anthracene,	N/A	
			1			Benzo(b)fluoranthene,	1	
			1			Dibenz(a,h)anthracene,	1	
			1			Indeno(1,2,3-cd)pyrene,	1	
	Surface Soil	Ingestion	3.5E-05		Benzo(a)pyrene	Chromium	N/A	
	Exposure Unit 7/8	Dermal Contact	4.1E-06		Donzo(a)pyrene	Benzo(a)pyrene	N/A	
	Exposure Offic 7/6	Dellilai Contact	4.1L-00		+	benzo(a)pyrene benzo(a)antinacene,	IN/A	
			1			Benzo(b)fluoranthene,	1	
			1			Dibenz(a,h)anthracene,	1	
			1			Indeno(1,2,3-cd)pyrene,	1	
		Total	3.9E-05		Benzo(a)pyrene	Chromium	N/A	
	All Media*	Total	2.8E-03			1	N/A	

^{*}Total Receptor Risks Across All Media are based on the addition of the maximum cancer risks for groundwater (Group 1) and the maximum risks for surface soil (Exposure Units 7/8 combined).

TABLE 5-3
Summary of RME Cancer Risks and Hazard Indices
Site UXO-08 Former Cantonment Bazooka Range, Base CS Chamber, NBC Training Trail, and D-7 Gas Chamber PA/SI Report
MCR Caml ei. North Carolina

Receptor	Media	Exposure Route	Cancer Risk	Chemicals with Cancer Risks >10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁵ and <10 ⁻⁴	Chemicals with Cancer Risks >10 ⁻⁶ and <10 ⁻⁵	Hazard Index	Chemicals with HI>1.0
		Ingestion	2.6E-06			Arsenic	1.6E-02	
	Sediment	Dermal Contact	3.1E-06			Arsenic	1.8E-02	
Current/Future Industrial Worker	Sealment	Inhalation	NA				NA	
ilidustilai vvoikei		Total	5.7E-06			Arsenic	3.4E-02	
	All Media	Total	5.7E-06				3.4E-02	
		Ingestion	1.1E-05		Arsenic		7.1E-02	
	O a di as a a t	Dermal Contact	2.3E-05		Arsenic		1.4E-01	
Current/Future Trespasser/Visitor Adult	Sediment	Inhalation	NA				NA	
rrespasser/visitor Addit		Total	3.5E-05				2.1E-01	
	All Media	Total	3.5E-05				2.1E-01	
		Ingestion	7.2E-06			Arsenic	1.1E-01	
		Dermal Contact	1.1E-05		Arsenic		1.6E-01	
Current/Future Trespasser/Visitor Youth	Sediment	Inhalation	NA				NA	
rrespasser/visitor routh		Total	1.8E-05				2.7E-01	
	All Media	Total	1.8E-05				2.7E-01	
		Ingestion	2.6E-05		Arsenic	Chromium	6.6E-01	
		Dermal Contact	4.5E-06			Arsenic	1.1E-01	
Current/Future Trespasser/Visitor Child	Sediment	Inhalation	NA				NA	
rrespasser/visitor Criliu		Total	3.0E-05				7.7E-01	
	All Media	Total	3.0E-05				7.7E-01	
		Ingestion	2.6E-06			Arsenic	1.6E-02	
		Dermal Contact	3.1E-06			Arsenic	1.8E-02	
Future Industrial Worker	Sediment	Inhalation	NA				NA	
mausmai worker		Total	5.7E-06				3.4E-02	
	All Media	Total	5.7E-06				3.4E-02	
		Ingestion	3.1E-06			Arsenic	4.6E-01	
Future Construction Worker		Dermal Contact	7.8E-07				1.1E-01	
	Sediment	Inhalation	NA				NA	
Construction worker		Total	3.8E-06				5.7E-01	
	All Media	Total	3.8E-06				5.7E-01	

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